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The FORCE XXI DDA Phases II and III Division CSS Analysis is an integral part of TRAC's DDA. This analysis addresses the feasibility and efficiency of the Force XXI CSS concept and candidate division CSS designs.

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In 1995, TRADOC initiated the analytical process described in the March 1995 draft Joint Venture (JV) Campaign Plan. The resulting analyses provide the basis for redesigning today's Warfighting Army for the 21st century. The Force XXI Division Design Analysis (DDA) process served as the thread of continuity for JV analyses. Division CSS analysis completed in support of the DDA process assessed the candidate CSS designs in the context of the Force XXI Division Operations Concept and compared their relative performances. Insights gleaned from DDA Division CSS Analyses address the overarching JV issue # 2: "How does the new CSS concept contribute to the effectiveness of the force?" The DDA Phases II and III insights, along with earlier insights documented in DDA Phase I, contributed to TRAC's assessment of this issue. Insights gleaned from both DDA Phases II and III analyses were consistent in their indications. The Force XXI CSS concept appears to be feasible in all designs and across all scenarios, given the presence of CSS enablers, fully resourced corps support, and the limited duration of the scenarios examined.

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Force XXI, Division Design Analysis (DDA), Combat Service Support (CSS), Interim Division Design (IDD), Conservative Heavy Division (CHD), Strike Division (STK), Brigadist (BDT),Maintenance Analysis, Supply Analysis

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STUDY TITLE: Division Design Analysis (DDA) Phases II and III Division Combat Service Support (CSS) Analysis Final Report

PURPOSE: The DDA Division CSS Analyses served as the thread of continuity for addressing the Force XXI Joint Venture CSS issue. The CSS analyses are an integral part of the DDA process, addressing the feasibility and efficiency of the Force XXI CSS concept and candidate division CSS designs. Insights gleaned from DDA Phases I, II, and III provide the constructive modeling analytical underpinnings for Force XXI division redesign decisions.

MAIN ASSUMPTIONS: The Division CSS Analysis incorporates all assumptions, constraints and limitations stated in TRADOC Analysis Center's DDA study report. From a CSS perspective, CSS enabling technologies are in place; Battlefield Distribution and Velocity Management (BD/VM) initiatives are mature; and EAD CSS units are fully resourced.

PRINCIPAL FINDINGS: The Force XXI CSS concept appears to be feasible in all designs and scenarios, given the presence of CSS enablers, fully resourced corps support, and the limited duration of the scenarios examined. However, the division's ability to exploit success and to continue into the next battle may be limited by critically low stockage levels at the end of the initial battle, particularly in the area of Field Artillery (FA) Class V. The Force XXI concept of operations and associated DISCOM structure introduces a greater dependence on technology and Corps CSS assets. Although not explicitly modeled in the constructive simulations, the CSS enablers are an essential part of the new CSS concept. Results clearly indicate that TAV does not necessarily equate to "timely" support and highlight the need for anticipatory logistics.

IMPACT: These findings raise concern about adequate resourcing of CSS enablers and Echelons above division CSS assets, since the Division CSS Analysis assumes that both will be available. Failure to fully fund and field the CSS enablers will limit the ability of CSS units to respond in an anticipatory manner, perhaps to the point of making the entire concept infeasible.

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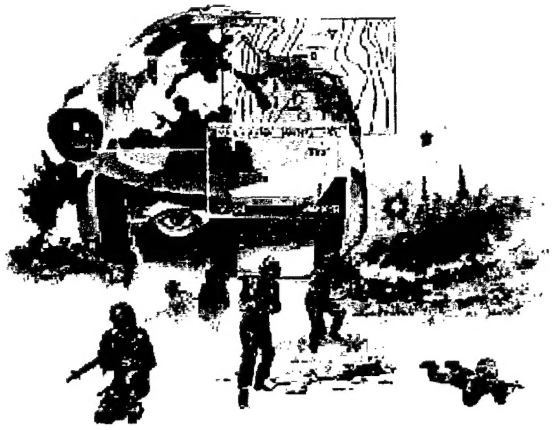
Force XXI
Division Design Analysis
Phases II and III

Division Combat Service Support Analysis
Final Report



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FORCE XXI
Division Design Analysis (DDA) Phases II and III
Division Combat Service Support (CSS) Analysis

FINAL REPORT

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DDA - Phases II and III
Division CSS Analysis
Final Report

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DDA PHASE II

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ACRONYMS & ABBREVIATIONS LIST

AC	Active Component
ACE	Armored Combat Earthmovers
ACR	Air Cavalry Regiment
ADA	Air Defense Artillery
ALO	Authorized Levels of Organization
AMEDD	Army Medical Department
AOE	Army of Excellence
ASL	Authorized Stockage List
ASP	Ammunition Supply Point
ATP	Ammunition Transfer Point
AVIM	Aviation Intermediate Maintenance
AVLB	Armored Vehicle Launched Bridge
AVLOG	Aviation Logistics
AWE	Advanced Warfighting Experiment
BD	Battlefield Distribution
BDAR	Battle Damage Assessment Repair
BDT	Brigadist
BLITCD	Battle Laboratory Integration Technology and Concepts Directorate
BOH	Balance-on-hand
BOS	Battlefield Operating System
BSA	Brigade Support Area
BSC	Base Support Company
C^2	Command and Control
CAA	Concepts Analysis Agency
CAMEX	Computer Assisted Map Exercise
CASCOM	Combined Arms Support Command
CEFA	CSS Enabler Functional Assessment
CEV	Combat Engineer Vehicle
CG	Commanding General
CGSC	Command General Staff College
CHD	Conservative Heavy Division
CHS	Combat Health Support
CMT	Contact Maintenance Truck
COA	Course of Action
COA	Course of Action
CS	Combat Support
CSB (DS)	Corps Support Battalion (Direct Support)
CSS	Combat Service Support
CTS	Contact Test Set
DA	Department of the Army
DASB	Division Aviation Support Battalion
DCD	Director of Combat Development
DDA	Division Design Analysis

DISCOM	Division Support Command
DIV CAV	Division Calvary
DS	Direct Support
DSB	Division Support Battalion
EAD	Echelon-above-division
ETM	Electronic Technical
FA	Field Artillery
FEA	Front End Assessment
FRS-H	Forward Repair System - Heavy
FSB	Forward Support Battalion
FSC	Forward Support Company
FSMC	Forward Support Medical Company
FSSP	Fuel System Supply Point
FSV	Future Scout Vehicles
FY	Force Year
HET	Heavy Equipment Transporter
HHC	Headquarters Company
HL-SB	Heavy/Light - Small Base
HMMWV	High Mobility Wheeled Vehicle
ICS3	Integrated Combat Service Support System
IDD	Interim Division Design
IETM	Integrated ETM
IFTE	Integrated Family of Test Equipment
IFV	Infantry Fighting Vehicle
ITV	Intransit Visibility
JCSEEA	Joint Close Support End-to-End Analysis
JV	Joint Venture
JVAMP	JV Analysis Management Plan
LMTV	Light Medium Tactical Vehicle
LOC	Lines of Communication
MARC	Manpower Requirements Criteria
METL	Division Mission Essential Task List
MHE	Materiel-handling equipment
MMH	Maintenance Man-hours
MOD	Modular Division
MOD HVY	Modernized Heavy
MSB	Main Support Battalion
MSR	Main Supply Route
MTS	Movement Tracking System
MTV	Medium Tactical Vehicles
NEA	North East Asia
OD	Ordnance
OOTW	Operations Other Than War
PLS	Palletized Loading System
PLS-E	Palletized Loading System-Enhanced

PW	Prairie Warrior
QM	Quartermaster
RAM	Reliability, Availability, and Maintainability
RC	Reserve Component
ROWPU	Reverse Osmosis Water Purification Unit
SA	Situational Awareness
SME	Subject Matter Expert
SSI	Soldier Support Institute
STK	Strike Division
SWA	South West Asia
SWC	Scenario and Wargaming Center
TAV	Total Asset Visibility
TC	Transportation Corps
TIGER	Tactical Interactive Ground Equipment Repair
TOE	Table of Organization and Equipment
TRAC	TRADOC Analysis Center
TRADOC	Training and Doctrine Command
TTP	Tactics, Techniques and Procedures
UBL	Unit Basic Load
VIC	Vector-in-Commander
VM	Velocity Management

STUDY TEAM & CONTRIBUTORS

The Division Design Analysis Division CSS Analysis team consisted of the following analysts and SMEs:

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The DDA Division CSS Analysis team wishes to acknowledge and thank all participants who shared their expertise. Your generous support made this study effort a success.

ABSTRACT

In 1995, TRADOC initiated the analytical process described in the March 1995 draft *Joint Venture (JV) Campaign Plan.* The resulting analyses provide the basis for redesigning today's Warfighting Army for the 21st century. The Force XXI Division Design Analysis (DDA) process served as the thread of continuity for JV analyses. Division CSS analysis completed in support of the DDA process assessed the candidate CSS designs in the context of the Force XXI Division Operations Concept and compared their relative performances. Insights gleaned from DDA Division CSS Analyses address the overarching JV issue # 2: "**How does the new CSS concept contribute to the effectiveness of the force?"** The DDA Phases II and III insights, along with earlier insights documented in DDA Phase I, contributed to TRAC's assessment of this issue. Insights gleaned from both DDA Phases II and III analyses are consistent in their indications. The Force XXI CSS concept appears to be feasible in all designs and scenarios, given the presence of CSS enablers, fully resourced corps support, and the limited duration of the scenarios examined.

Force XXI
DDA Phases II & III

Division CSS Analysis

Executive Summary

Division Design Analysis (DDA) Phases II and III
Division Combat Service Support (CSS) Analysis
Final Report

Executive Summary

1. Introduction.

a. ***Purpose.*** In 1995, Training and Doctrine Command (TRADOC) initiated the analytical process necessary to redesign today's Warfighting Army for the 21st century. The March 1995 draft *Joint Venture (JV) Campaign Plan* authored by TRADOC Battle Laboratory Integration Technology and Concepts Directorate (BLITCD) described the process. The DDA Analyses provide the analytical framework for Force XXI Division design constructive modeling, simulation, and analysis. These analyses serve as the thread of continuity for the JV process. Insights gleaned from DDA Phases I, II and III provide the analytical underpinnings for Force XXI division redesign decisions. The associated Division CSS analyses, which are an integral part of the DDA process, address the feasibility and efficiency of the Force XXI CSS concept and candidate division CSS designs.

b. ***Background.*** The DDA - Phase I Division CSS analysis consisted of purely qualitative insights gleaned from Subject Matter Expert (SME) surveys and CSS planning factor calculations. At the end of Phase I, in December 1995, the Commanding General (CG), TRADOC chose the Interim Division Design (IDD) Modernized Heavy variant for further analysis and experimentation. The second phase of DDA was conducted from January 1996 through May 1997. This phase included both qualitative and quantitative analyses. Insights from DDA - Phase II, the Task Force XXI Advanced Warfighting Experiment (AWE), and the Combined Arms Support Command (CASCOM) "Right Size" Division Support Command (DISCOM) initiative pointed to possible deficiencies in the IDD. Additionally, further guidance capped the overall end strength of the Force XXI Division at 15,000. Emerging insights and the 15,000 personnel end-strength cap established a need for additional analysis. During May 1997, the CG, TRADOC approved three new division designs (Conservative Heavy Division (CHD), Strike (STK), and Brigadist (BDT)) for further analysis (DDA - Phase III) and experimentation.

c. ***CSS Issues***. The JV Analysis Management Plan identified over-arching issues for the Force XXI JV analyses and experiments. These issues identified several broad areas for investigation. The JV issue number 2 (JV2) focused on CSS. This issue reads as follows: ***Do the Force XXI Combat Service Support (CSS) concept, structures, and systems support the Force XXI Division operational concept?***

d. ***Concept and Force Structure.*** The Force XXI division operations concept, described in TRADOC Pam 525-71, *Force XXI Division Operations Concept*, March 1996, serves as the foundation for analyzing all proposed organizational designs for the Force XXI division. The basis of each candidate Force XXI design is an objective force employing 2010 technology. CASCOM's final draft concept paper, *CSS Operations in Support of Force XXI Division Redesign, September 1996,* outlines the Force XXI CSS concept. The new CSS concept

proposes organizational and operational changes based on modularity and multi-functionality, along with a common relevant picture of the battlefield. Force XXI division CSS structures are smaller and more maneuverable than the Army of Excellence (AOE) structure. The smaller structure result from a consolidation of support activities and the assumption that advanced information technology will be available to the CSS community within the 2010 timeframe. The proposed structure also requires a greater reliance on echelon-above-division (EAD) units in the areas of supply distribution and maintenance. The logistics portion of CSS Command and Control (C^2) structure parallels the combat C^2 structure. Habitual relationships continue to exist between CSS units and the units they support. Although EAD design for Force XXI has not been developed, the CSS community projects that most EAD CSS units will remain functionally oriented and provide support on an area basis. A brief description of the primary candidate designs follow.

(1) The IDD MOD HVY design, evaluated in DDA - Phase II, contains 15,820 personnel, with 4,209 in the DISCOM. The DISCOM elements include a Headquarters Company (HHC), a Division Support Battalion (DSB), and three Forward Support Battalions (FSB). The FSB includes a Base Support Company (BSC), along with Armor and Mechanized Infantry Forward Support Companies (FSCs)

(2) The CHD design is a modification of the IDD. There are 15,071 personnel in the CHD Mechanized Infantry variant. The CHD structure is similar to that proposed for the IDD with three major exceptions. First, the maneuver battalions are built as three-company, armor and mechanized infantry combined arms battalions (CABs). Second, the CHD eliminates an engineer group headquarters. Finally, the CHD DISCOM differs from that of the IDD. The CHD DISCOM, with 4,321 personnel, is larger than that of the IDD. This DISCOM includes a Division Aviation Support Battalion (DASB) separate from the DSB. Engineer Support Platoons, located in the BSC of the FSB, replace the CSS assets previously located in the Engineer battalion.

(3) The STK Division includes 14,574 personnel. This design consists of two ground maneuver brigades (with four CABs each), and the Strike Brigade which integrates aviation and light infantry assets. The STK division includes more long-range fire capabilities than either the CHD or the BDT design. The Strike Division's CSS concept and structure closely follow that prescribed for the CHD although this DISCOM contains fewer personnel (3,952).

(4) The BDT design, built around three semi-autonomous brigades, contains 13,950 personnel. Most of the traditional Combat Support (CS) and CSS elements are organic to the brigade and not the division base. That is, cavalry, engineers, signal, military intelligence, and air defense artillery are organic to the maneuver brigades. The major exception is direct support Field Artillery (FA), which still resides in Division Artillery (DIVARTY). This division has only one MLRS battery and no striker assets. Major division based functions that have been reduced, eliminated, or passed to EAD include DISCOM, counter-battery, deep fires, division-level ground cavalry, and signal support. The FSB CSS assets for the maneuver brigades and the DIVARTY are embedded in the respective units. The total number of CSS personnel embedded in this design is 4,274.

e. ***Scenario Overview.*** The LANTICA, North East Asia (NEA), and South West Asia (SWA) scenarios underlie the DDA simulations. The TRAC Scenario and Wargaming Center adapted the Command General Staff College Prairie Warrior 96 LANTICA scenario for use in DDA - Phase II modeling. The LANTICA 3 scenario (a vignette modification of the Division AWE scenario); the NEA scenario (an adaptation from the Joint Close Support End-to-End Analysis (JCSEEA); and a SWA adaptation from JCSEEA served as the basis for DDA Phase III modeling. The LANTICA scenarios, with their long lines of communication (LOC) and main supply route (MSR) congestion, place the most stress on the CSS concept and force structure. The NEA scenarios provide an opportunity to examine the candidate designs in a restricted terrain environment; while, SWA showcases the division in isolation, without Corps support.

f. ***Assumptions, Constraints and Limitations.*** The Division CSS Analysis incorporates all assumptions, constraints and limitations stated in the DDA study report. From a CSS perspective, CSS enabling technologies are in place; Battlefield Distribution and Velocity Management (BD/VM) initiatives are mature; and EAD CSS units are fully resourced. Model constraints, CSS concept maturity, and time limited the depth of this analysis.

2. Study methodology. Figure ES-1 provides an overview of the DDA process. A combination of SME judgement and simulation based analytical underpinnings serves as the foundation for insights documented in these analyses. The qualitative and quantitative analytic tools used include mapboard exercises, SME conferences, and constructive simulation. Supplemental tools included literature searches, planning and decision support tools, and spreadsheet software. Outputs from the CSS module of the Vector-in-Commander (VIC) model provided the analytical basis for comparing the effectiveness of the CSS designs. The analysis focused on the CSS system's ability to support each candidate division design within the context of the overall force. Maneuver unit stock balances over time served as the primary measure of effectiveness. A lack of zero stock balances throughout the supply system was considered a positive indicator of the CSS system's ability to meet demands in a "timely" manner.

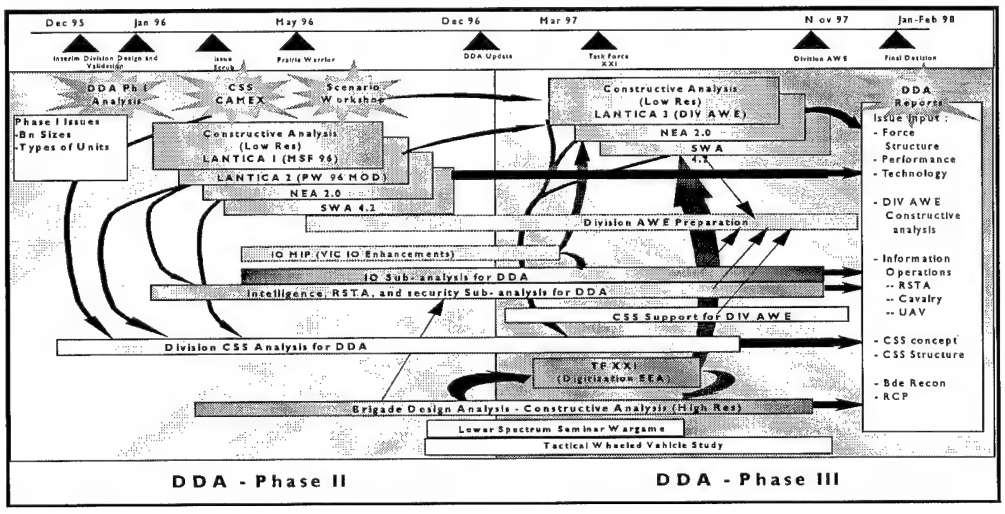


FIGURE ES-1: DDA Study Methodology

3. Conclusions and Recommendations.

a. ***Contribution of the CSS concept to the effectiveness of the force: Ability to support the offensive orientation of the Force XXI Division operations concept and ability to support the Force XXI Division for reorganization for follow-on operations.*** Insights gleaned from both DDA Phases II and III analyses are consistent in their indications. The Force XXI CSS concept appears to be feasible in all designs and scenarios, given the presence of CSS enablers, fully resourced corps support, and the limited duration of the scenarios examined. The respective combat elements of all Force XXI division designs, along with their supporting Corps CS slices, were able to accomplish all missions. At no point in any of the scenarios did a lack of fuel or ammunition prevent a unit from successfully completing its mission. However, the division's ability to exploit success and to continue into the next battle may be limited by critically low stockage levels at the end of the initial battle, particularly in the area of Field Artillery (FA) Class V. The stressful CSS environment encountered in the LANTICA scenarios demonstrates that the time-distance factors associated with extended LOCs and MSR congestion inhibit "timely" resupply. Results clearly indicate that TAV does not necessarily equate to "timely" support and highlight the need for **anticipatory** logistics.

(1) Additional analysis is needed to fully assess the robustness of the Force XXI division CSS concept. It is important to note that the VIC model does not represent anticipatory logistics. There is no man-in-the-loop to do the up-front planning necessary to be able to push resupplies forward at the right time and to appropriate positions on the battlefield in anticipation of requirements. The methodology essentially represents a pull-system. However, the model did allow for near real time visibility of supply consumption (stockage levels are reviewed for every unit once an hour) and supplies were ordered whenever stockage levels reached predetermined thresholds.

(2) In all scenarios, FA consumption rates stressed the Force XXI CSS concept; Corps throughput for class V resupply. A method for combating the problems associated with the Force XXI operational concept's extended LOCs and high firing rates must be found. As the CSS concept continues to be refined, serious consideration should be given to extending the modular support FSC concept to both divisional and EAD artillery units operating in support of the division. At a minimum, the organic ammunition transfer point (ATP) capability of the CHD should be retained (18 spaces). Additionally, problems encountered in the NEA 2.0 scenario highlight the need to evaluate supply stockage policies and the EAD CSS design. The stockage levels and placement of ammunition supply point (ASP) support of the division should be re-evaluated.

(3) Finally, MSR and rear-area security issues are a concern for all designs. In the LANTICA scenarios, rapid maneuver extends the LOC out to 300 kilometers by the end of the scenario. In addition to the time-distance factor problems, this also raises serious security issues. The loss of even a few resupply convoys will compound an already serious situation as units await critical through-put resupply from Corps. How and by whom LOCs will be secured are issues, which must be addressed.

b. ***Effects of the Force XXI CSS concept on logistical operations.*** Conclusions related to this issue were gleaned primarily from DDA - Phase II analysis. The Force XXI concept of operations and associated DISCOM structure introduces a greater dependence on Corps CSS assets. The rapid maneuver on a dispersed battlefield, coupled with reduced resources within the division, resulted in a greater reliance on EAD support. The Force XXI concept's pace of maneuver dictates that resupply operations occur forward on the battlefield while repair operations move to the rear. The ability to conduct refuel-on-the-move operations and to throughput Class V munitions to the maneuver elements is essential to successful execution of the Force XXI concept. The maintenance focus is to replace forward and to repair in the rear. Adequate recovery and evacuation assets, as well as multi-functional mechanics, play an important role in any design that supports the Force XXI division. This raises concern over future ALO requirements and adequate resourcing of EAD CSS assets since the Division CSS Analysis assumes that corps support will be available. From a CSS perspective, **anticipation** and **flexibility** are key to providing "timely" support.

c. ***The utility of CSS enabling technologies on the execution of the CSS concept.*** Conclusions related to this issue were gleaned primarily from DDA - Phase II analysis. Although not explicitly modeled in the constructive simulations, the CSS enablers are an essential part of the new CSS concept. The CSS enabling technologies provide situational awareness (SA) and total asset visibility (TAV), the primary tenets of the Force XXI CSS concept. These technologies are necessary for the anticipation and flexibility inherent in the Force XXI CSS concept. They allow the CSS system to adequately support the fast paced battle dictated by the Force XXI operational concept. The CSS units must be able to maintain SA, monitor status in near real time, anticipate requirements and respond rapidly on a highly dispersed battlefield. Failure to fully fund and field the key CSS enablers will limit the ability of CSS units to do this, perhaps to the point of making the entire concept infeasible.

(1) The limited CSS enabler representation in the VIC model indicates that the CSS concept's dependence on technology elevates the level of risk associated with providing adequate and "timely" CSS. An unexpected loss of the CSS enablers (represented in the VIC model as a delay in the reorder assessment interval) lengthened the resupply waiting period, lowered fuel balances in the units and exacerbated Class V resupply problems for FA units.

(2) The CSS SMEs expect enabling technology to aid in CSS force reduction by offsetting requirements. At this time, the only CSS enabler projected to provide near-term space savings is the 1500 gallon per hour Reverse Osmosis Water Purification Unit. Maintenance proponents project that several enablers and initiatives, which have space saving potential, will be in place by 2010. These include the Tactical Interactive Ground Equipment Repair Initiative, Contact Test Set/Integrated Family of Test Equipment, Electronic Technical Manuals (ETM)/Integrated ETM, Contact Maintenance Truck, Forward Repair System – Heavy, Hercules, and the multifunctional maintainer. Other projected requirement offsets included Palletized Loading System-Enhanced, Movement Tracking System, and automation initiatives such as Integrated Combat Service Support System. The SMEs stated that fully funding enablers will reduce space requirements to the levels proposed in the candidate Force XXI CSS force structures.

(3) Several other Force XXI CSS analyses were conducted within the same timeframe as the DDA. They include the JV Capstone CSS Analysis, CEFA, Task Force 21 AWE CSS Analysis, and Division AWE CSS Analysis. Each of these study efforts contains further insights regarding the utility of CSS enablers and risks associated with the unexpected lost of the same.

d. ***Optimization of the CSS concept and force design in support of Force XXI.*** Because of the fidelity of the VIC model and the maturity of the CSS concept, SME judgement provided the only basis for addressing this issue. The CSS SMEs participating in the "Right Size" DISCOM Initiative addressed alternative ways to support the candidate Force XXI designs, assuming the CSS force structure ceiling was a given. The alternatives included status quo, salami slicing functions, AC/RC integration, balancing the combat force with the supporting force, EAD pass-back and taking advantage of technology. However, none of these alternatives optimizes the CSS force design. Each has inherent drawbacks. The SMEs focused their attention on passing portions of the workload back to EAD.

Force XXI
DDA Phase II

Division CSS Analysis

Division Design Analysis (DDA) Phase II
Division Combat Service Support (CSS) Analysis
Final Report

CHAPTER 1
Introduction

1.1. Purpose. The Training and Doctrine Command (TRADOC) Analysis Center (TRAC) conducted the Force XXI Division Design Analysis (DDA) - Phase II to analyze and make recommendations for design modifications to the Force XXI objective division. This report documents the Division CSS Analysis, an integral part of DDA - Phase II. The Division CSS analysis addresses the feasibility and efficiency of the Force XXI CSS concept and the Interim Division Design (IDD) Modernized Heavy (MOD HVY) CSS force structure in the context of constructive wargaming. Insights gleaned from the Division CSS Analysis will contribute to TRAC's assessment of the overarching Joint Venture (JV) CSS issue.

1.2. Background. In 1995 TRADOC initiated the analytical process described in the March 1995 draft *Joint Venture Campaign Plan* authored by TRADOC Battle Laboratory Integration Technology and Concepts Directorate (BLITCD). The resulting analyses provide the basis for redesigning today's Warfighting Army for the 21st century. The DDA process serves as the thread of continuity for JV analyses.

a. ***DDA - Phase I.*** The DDA - Phase I Analysis examined a set of alternative division designs. Initially three alternative division designs (the Current Army of Excellence (AOE), the Heavy/Light - Small Base (HL-SB), and the Brigade Based) were examined. During the study two additional design alternatives, the Modular Division (MOD) and the MOD HVY, were added. The DDA - Phase I analysis results provided the analytical underpinnings for the Commanding General (CG), TRADOC's December 1995 IDD decision (the MOD HVY design). The CSS analysis results contained in DDA - Phase I consisted of purely qualitative insights gleaned from Subject Matter Expert (SME) surveys and CSS planning factor calculations.

b. ***DDA - Phase II.*** The second phase of the DDA began in January 1996 and culminated in June 1997. The objective of DDA - Phase II was a more in-depth examination of the IDD MOD HVY chosen in December 1995. This phase of DDA relied heavily on constructive modeling. The DDA CSS Computer Assisted Map Exercise (CAMEX), conducted from 4 - 12 March 1996 at Fort Lee, Virginia, was the first large scale, detailed exercise of the new CSS concept and design. Insights from that exercise were used to identify potential bottlenecks in the proposed CSS concept and organization, refine the concept, as appropriate, and establish a foundation for further constructive wargaming and experimentation. The Division CSS Analysis documented in this report examined the proposed CSS concept and force structure established during the CSS CAMEX, along with modifications provided by SMEs participating in the Combined Arms Support Command (CASCOM) "Right Size" Division Support Command (DISCOM) force development initiative. Emerging insights from ongoing DDA - Phase II analysis, results from the Task Force XXI Advanced Warfighting Experiment (AWE),

preparation for the Division AWE and the findings of CASCOM's "Right Size" DISCOM initiative pointed to possible deficiencies in the proposed IDD.

c. ***DDA - Phase III***. The insights from DDA - Phase II lead to changes in the proposed IDD. The CG TRADOC approved three additional designs (Conservative Heavy (CHD), Strike (STK), and Brigadist (BDT)) for analysis and experimentation. During the third phase of DDA, each of the new designs underwent analysis within the context of three scenarios (LANTICA 3, North East Asia (NEA) 2.0, and South West Asia (SWA) Halt). In addition, the CHD design was exercised in the November 1997 Division AWE. The final division design decision will be made in February 1998.

1.3. Study Issues. The JV Analysis Management Plan (JVAMP) identified the over-arching issues for the various JV analyses and experiments. These issues identify several broad areas for investigation. The JV issue number 2 (JV2) focused on CSS and reads as follows: Do ***the Force XXI Combat Service Support (CSS) concept, structures, and systems support the Force XXI Division operational concept?*** The four CSS issues delineated below provide a framework emphasizing those aspects of the JV CSS issue addressed in this analysis.

a. How does the new CSS concept contribute to the effectiveness of the force?

(1) Does the Force XXI CSS concept support the offensive orientation of the Force XXI Division operations concept?

(2) Can the CSS concept and organization support the Force XXI division for reorganization for follow-on missions?

b. What effects does the CSS concept have on logistical operations?

c. What is the utility of CSS enabling technologies on execution of the CSS concept?

d. How is the CSS concept and force design optimized in support of Force XXI?

1.4. Scope. The DDA - Phase II Division CSS Analysis is one element of the overall CSS JV Analysis. This analysis focused on the IDD MOD HVY CSS concepts and structures; however, consideration was given to the division's CSS requirements in the corps context. The analysis was performed for two force years (FY): 2003 (near-term) and 2010 (far-term). Performing the near-term analysis allowed an assessment of how organizational changes, with minimal technology insertions, affect the capabilities of today's force; while, the far-term analysis provided insights on the synergistic effects of force structure changes in combination with higher technology systems. The threat for both force years was projected at the FY 2010 time frame. This provided a robust threat for the near-term force and "leveled the playing field" for the far-term.

1.5. Concept and Force Structure. The Force XXI division operations concept, described in TRADOC Pam 525-71, *Force XXI Division Operations Concept*, March 1996, serves as the

foundation for developing the organizational designs of Force XXI divisions. The concept states; *"Force XXI divisions will retain only core division functions while maintaining the capability to execute all missions assigned to Army of Excellence (AOE) divisions."* It also outlines the Force XXI design principles and pattern of operations for CSS as follows:

> *The Force XXI division must be able to mount, sustain, and recover from operations simultaneously. The division must be capable of continuous operations so that the basic process of plan, prepare, execute, and recover is seamless. It must also be capable of conducting prolonged operations. There will be no discernable break between decisive operations, reconstitution, and if necessary redeployment. Concurrent with battlefield clean-up and exploitation, the division will either prepare in place for follow-on operations, reorganize, or move to a new support area for regeneration. Logistics organizations must be modular, tailorable, and flexible to sustain future Army operations. Organizational design must facilitate operations in a split-based, remote, or secure configuration and employ Information Age technologies to produce a seamless support system.*

The Force XXI CSS concept, outlined in CASCOM's Final Draft concept paper, *CSS Operations in Support of Force XXI Division Redesign, September 1996,* proposes organizational and operational changes designed to meet the support challenges noted above. Modularity and multifunctionality, along with a common relevant picture of the battlefield, form the cornerstones of the Force XXI CSS concept. As a result of the proposed changes, the division's CSS structure becomes smaller and more maneuverable. The smaller structure results from a consolidation of support activities and the assumption that advanced information technology will be available to the CSS community within the study timeframe (2010). The proposed structure also requires a greater reliance on echelon-above-division (EAD) units in the areas of supply distribution and maintenance. The logistics portion of CSS Command and Control (C^2) structure parallels the combat C^2 structure. Habitual relationships continue to exist between CSS units and the units they support. At EAD most CSS units remain functionally oriented and provide support on an area basis.

a. Figure P2-1 depicts the IDD MOD HVY force structure that contains 15,820 personnel. The highlighted section is the DISCOM, the focal point of the Division CSS analysis. The DISCOM's elements include a Headquarters Company (HHC), a Division Support Battalion (DSB), and three Forward Support Battalions (FSBs). The three subparagraphs that follow provide a brief description of each of these elements. See CASCOM's Final Draft concept paper, *CSS Operations in Support of Force XXI Division Redesign, September 1996,* for in-depth composition and mission descriptions.

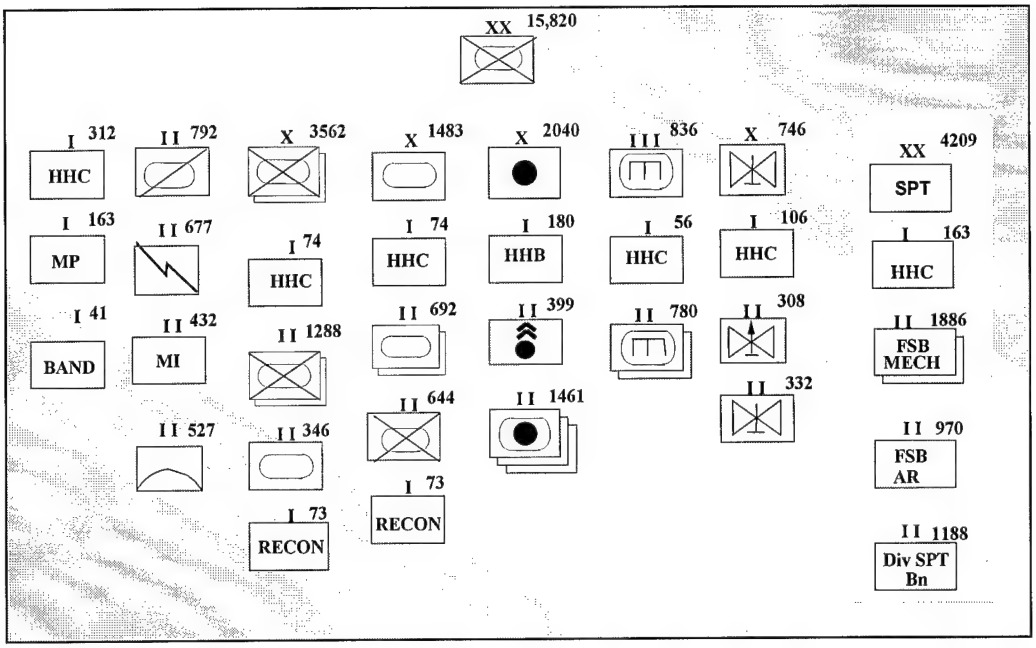


FIGURE P2-1: IDD MOD HVY Division

(1) HHC. This element exercises C^2 over all CSS units that are organic in or attached to the MOD HVY division. The HHC coordinates and synchronizes all support requirements and activities inside and outside the division.

(2) DSB. The IDD MOD HVY DSB is functionally organized. Quartermaster (QM), transportation, direct support (DS) maintenance, aviation maintenance (ground and Aviation Intermediate Maintenance (AVIM)), and medical elements provide logistical support to Division troops not attached to a maneuver brigade. These units also provide modular direct support to dispersed combat, combat support (CS), and CSS units that lack organic support in the division. Finally, the QM and transportation elements provide reinforcing Class III (bulk) to the FSBs, and area support to units located in the Division Support Area.

(3) FSB. The IDD MOD HVY FSB is a multifunctional unit in direct support of an armor or mechanized infantry brigade. This FSB contains a HHC, a Base Support Company (BSC), armor and mechanized Forward Support Companies (FSCs), and a Forward Support Medical Company (FSMC). These multi-functional logistics companies within the IDD MOD HVY FSB are the products of consolidating CSS organizational elements embedded in the AOE maneuver battalion with the DS capability in the AOE FSB.

(a) BSC. This unit provides logistics support to the brigade rear area (less medical and Class VIII). It also provides limited backup and reinforcing support to the FSCs. This element's headquarters provides C^2 to all organic and attached elements, coordinates area support within the Brigade Support Area (BSA), and coordinates reinforcing support to the FSCs. Supply and transportation responsibilities include Class I, II, III(P), IV, VI, and VII direct support; maintenance of the Brigade's Class IX combat Authorized Stockage List (ASL); operation of the

Brigade's ammunition transfer point (ATP); establishment and operation of the water point for the BSA; and Class III(B) direct support to the FSCs, as well as, Class III(B) area support for the brigade. The BSC also provides tactical field maintenance to the Brigade headquarters and the Brigade Reconnaissance Troops; area DS maintenance for the artillery battalion supporting the brigade and other units operation in the BSA; and limited reinforcing and back up support to the FSC maintenance platoon.

(b) FSC. The FSC is a multifunctional unit organized to support an armor or mechanized battalion. This unit provides direct and habitual CSS and combat health support (CHS) to include all classes of supply; tactical field maintenance (DS and Unit) and recovery; food services; and medical support. The FSC is mobile and capable of maintaining pace with its supported maneuver battalion. Its modular design allows for the cross attachment of specific functions and capabilities when supporting a mechanized or armor task force.

(c) FSMC. This unit provides CHS to all units operating in the BSA. This company provides treatment of patients with disease and non-battle injuries, battle fatigue, and trauma injuries. It also provides the following services: routine sick call, triage of mass casualties, advanced trauma management, surgical resuscitation and stabilization, ground evacuation for patients from the battalion aid stations, emergency sustaining dental care, medical laboratory and radiology services, patient holding, limited reinforcement and augmentation to supported medical elements of forward units, and medical resupply to all units in the brigade area.

b. Figure P2-2, extracted from *Front End Assessment (FEA) for CSS Operations at EAD* (draft), TRAC-Lee, May 1997, depicts the CS corps slice associated with the IDD MOD HVY force structure portrayed in the LANTICA 2 scenario.

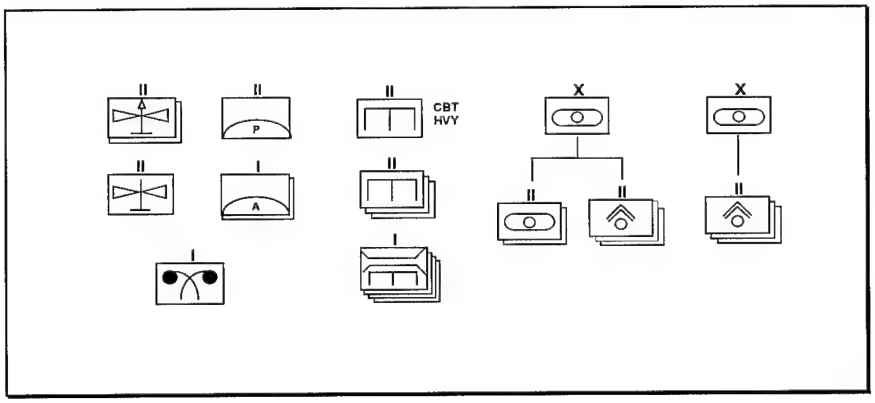


FIGURE P2-2: IDD MOD HVY Division, CS Corps Slice for LANTICA 2

1.6. Scenario Overview. Simulations used in DDA – Phase II were based on the LANTICA 2 and the NEA 2.0 scenarios. Each scenario portrayed Force XXI division force structures. Corps CS and CSS augmentation differed because of tailoring for the specific warfighting conditions. The next two paragraphs provide a summary description of the scenarios modeled. See the main DDA report for an in-depth portrayal of these scenarios.

a. ***LANTICA 2.*** The TRAC Scenario and Wargaming Center (SWC) adapted the Command General Staff Collage (CGSC) Prairie Warrior (PW) 96 LANTICA scenario for use in DDA - Phase II modeling. The warfight in this scenario takes place on the island of Lantica, a fictitious location with European-type terrain. The Corps mission was to attack and destroy the opposing force and restore the integrity of the international border. The Corps contains two Force XXI divisions attacking a hypothetical, high technology opposing force. The Division CSS analysis focuses on only one of those divisions, the Corps main effort. That division conducts a movement to strike mission under conditions of air parity. The simulated warfight lasted approximately 30 hours before the mission was accomplished.

b. ***NEA 2.0.*** The NEA 2.0 scenario portrays a forward deployed IDD MOD HVY division (two brigades reinforced with one corps field artillery (FA) brigade) which is OPCON to a Host Nations Corps. The division's mission is to conduct a well-prepared deliberate defense that will permit the second echelon forces to establish prepared defenses. This defense takes place early in the campaign before significant U.S. follow-on forces deploy. The IDD MOD HVY division must defeat the opposing force's lead divisions that are equipped with low to moderate technology and attrit their follow-on forces. To accomplish this mission the Force XXI forces must capitalize on a series of cross-compartmental terrain features in the division's sector and employ joint/combined synchronized deep fires. The Blue division must locate and destroy critical artillery, logistics convoys, and signal nodes. This warfight required approximately 48 hours for mission completion.

1.7. Constraints and Limitations. In addition to the limitations described in the main body of the DDA – Phase II study report, the following apply to this analysis:

a. Subjective military judgment and qualitative analyses will be used to address those CSS issues that cannot be adequately defined within the context of the scenarios being executed by current analytic tools.

b. Dynamic models are restricted in CSS fidelity and resolution and may not fully stress the CSS system.

c. Some CSS tasks and functions that are anticipated to be automated in the objective force require simulation "work-arounds" because they cannot be explicitly represented.

1.8. Assumptions. All assumptions stated in the main body of the DDA study report apply to this analysis. In addition, the following were assumed:

a. CSS enabling technologies are in place. An assessment of the risks associated with this assumption will be documented in the CSS Enabler Functional Assessment (CEFA) being completed as one component of the JV Capstone CSS Analysis.

b. Battlefield Distribution/Velocity Management (BD/VM) initiatives are mature.

c. All EAD CSS units are fully resourced at Authorized Levels of Organization (ALO) 1 to meet the Force XXI division's external requirements.

d. Projected technological capabilities are valid and information can be generated or surrogated to represent these capabilities.

1.9. Study methodology. A combination of SME judgement and simulation based analytical underpinnings serve as the foundation for insights documented in this report. The qualitative and quantitative analytic tools used include mapboard exercises, SME conferences, and constructive simulation. Supplemental tools included literature searches, planning and decision support tools, and spreadsheet software.

a. ***Qualitative analysis.***

(1) CSS THINKX. To begin refinement of the CSS concept, TRAC-LEE hosted a planning exercise from 5 - 9 February 1996. The CASCOM SMEs provided information in the CSS tactical areas of Man, Fuel, Sustain, Arm, Move, and Fix. The SMEs reviewed the Force XXI CSS concept and design from DISCOM commander and staff perspectives. The PW96 (modified) scenario and the MOD Division, a phase I alternative design, provided the basis for the exercise. The battle followed the phases used in the November 1995 CAMEX. The SMEs used the operational intervals and the new concept to determine the support strategy for the maneuver elements. They also provided an initial assessment of how well the new force structure and CSS concept appeared to support the division. The CSS THINKX served as a training session for the follow-on CAMEX-based exercise held in for March 1996.

(2) CSS CAMEX. TRAC-LEE sponsored a CSS CAMEX from 4 - 12 March 1996. Like THINKX, this exercise used the PW96 (modified) scenario; however, the force structure was changed from the MOD division design to the IDD MOD HVY design. The primary players were SMEs from CASCOM. Additionally, SMEs from the Infantry, FA, and Aviation Schools participated as the G-3, deputy fire support coordinator (DFSCOORD), and aviation brigade commander, respectively. This exercise required many manual "work-arounds" to accomplish CSS tasks and functions that are anticipated to be automated in the objective force. The CSS CAMEX provided a review of the CSS concept and organization in the context of a constructive wargame. It allowed the participants to refine the concept and establish a foundation for further analysis and experimentation. The exercise also provided a forum to assess proposed Force XXI CSS tactics, techniques and procedures (TTP) which will support the MOD HVY division.

(3) "Right Size" DISCOM Initiative. The CG, CASCOM launched this effort in December 1996 to determine the appropriate size and composition of the IDD MOD HVY DISCOM. The "Right Size" DISCOM Initiative served as CASCOM's methodology for developing a Force XXI CSS concept and force structure. The products of this effort include the "Right Size" IDD MOD HVY DISCOM, the CSS community's input for DDA - Phase III modeling and the CSS structure for Division AWE experimentation. Its analytical bases are Manpower Requirements Criteria (MARC), planning factors, and SME judgement.

b. ***Quantitative analysis***. Output produced by Vector-in-Commander (VIC) modeling of the LANTICA 2 and NEA 2.0 scenarios provide the quantitative bases of the Division CSS analysis. Results are based on snapshots taken at three-hour intervals during the 30-hour LANTICA 2 scenario and four-hour intervals during NEA 2.0. *DDA - Phase II CSS Analysis of VIC Dynamic Gaming Technical Reports*, on file at TRAC-Lee, provide in-depth documentation of the results of each wargame.

(1) Gaming of the battle flow from the CSS CAMEX produced the initial set of quantitative data. An examination of this data occurred at the beginning of June 1996 during a workshop designed to look at the data and produce planning products for a specific course of action (COA) for a follow-on mission. SMEs from several centers and schools and TRADOC Threat Support Directorate participated in this workshop. The CASCOM SMEs performed a qualitative assessment of the support structure's ability to reorganize as they do the detailed planning to rearm and refit the division in preparation for the follow-on mission. In addition, they developed the logistics estimate, a logistics preparation of the battlefield report, and a CSS overlay for the follow-on mission.

(2) The logistics estimate, logistics preparation of the battlefield report, and CSS overlay for the follow-on mission became input for the low-resolution VIC gaming of the LANTICA 2.0 scenario referred to in this analysis as the Base Case. This simulation ran 30 hours before mission completion. The data produced during Base Case gaming of the LANTICA 2 scenario provided the basis for addressing the question of whether the Force XXI CSS concept and the IDD MOD HVY force structure can adequately support the Force XXI division operations concept. The VIC gaming of the NEA 2.0 scenario provided a reference point for the Base Case data. Analysis of the data focused on tactical Class III and Class V resupply and the maintenance functions of repair, recovery, and evacuation. At the same time, Base Case data, alone, could not be used to provide insights that address the remaining issues outlined in the Division CSS analysis. Addressing these issues required comparative analysis. The VIC modeling excursions, described in the paragraphs below, were completed to provide data for comparisons.

(a) The Extension. The Base Case Extension continued gaming for an additional 24 hours (H+30 to H+54). The primary reason for extending the base case was to allow the CSS system to continue its missions. Data generated by this excursion provided insights in three areas: the length of time required to provide Class III and Class V resupply for the division and its supporting Corps CS elements, transportation asset availability, and the level of maintenance activity required to repair damaged weapon systems that were in maintenance at the end of base case gaming.

(b) AOE Excursion. This excursion regamed the Base Case while employing an AOE force structure to execute all combat, CS, and CSS missions. Going to an AOE force structure changed three parameters: the concept of operations; the number and types of weapon systems and units in the division; and the CSS concept. Data produced by this excursion addressed the effects the Force XXI concept will have on logistical operations. As in the Base Case, forces modeled in the AOE excursion use 2010 weapon system technologies.

(c) The Alternative. Like the AOE excursion, the Alternative also regamed the Base Case. It employed Force XXI combat, CS, and CSS concepts and the MOD HVY IDD force structure. This excursion portrayed the loss of Situational Awareness (SA) and Total Asset Visibility (TAV) between the CSS elements by changing the reorder assessment time between Blue CSS elements from one-hour (the Base Case) to 12-hour intervals (the Alternative).

(d) Near-Term Excursion. The Base Case Near-Term excursion addressed the impacts of changing technology within the combat and CS units. As the name implies, this excursion regamed the Base Case. It retained the Force XXI concept and MOD HVY IDD force structure while using 2003 weapon system technology to execute the combat mission.

c. ***Models.***

(1) CAMEX. The CAMEX model was selected for the DDA to accommodate time constraints and for its value as a qualitative analysis tool. Its propensity to serve as a discussion driver, highlighting observations and insights that can easily go unnoticed in other models, made CAMEX a natural choice to analyze new technologies and organizational structures with minimal bias to any particular weapon system or functional area. CAMEX is TRAC's division/corps-level model that allows for human interaction (man-in-the-loop) while using deterministic processes. Developed in-house, the CAMEX model is based on modules from VIC. CAMEX and VIC use common data files as well as common attrition and movement algorithms. CAMEX differs significantly from VIC, however, in both C^2 and time delay processes.

(2) VIC. The VIC model is a two-sided, deterministic simulation of integrated land and air combat. The level of resolution is the maneuver battalion. VIC is event stepped for maneuver elements and both time and event stepped for calculation of CSS effects. The representation of C^2 in this model consists of sets of tactical decision rules which describe and control the decision making process and implement synchronization events that affect movement and fire support. Consumption among Combat, CS, and CSS units generate the CSS system's workload. Two modules within VIC represent the CSS system: Logistics (supply) and Return-to-Duty (maintenance).

(a) Logistics. This module explicitly represents the tactical CSS functions of arm, fuel, and move. Resupply for other supply classes are rolled up into short tons per day to stress transportation requirements. Resupply and transportation activities may be constrained by stock availability at supply units, truck availability, load and unload times, congestion on the main supply routes (MSRs), and travel time between the unit and its suppliers. Attrition and movement of supply units, caused by combat, degrade the resupply system's ability to perform. Resources that can be lost at the supply units include trucks, stocks, and materiel-handling equipment (MHE). The relocation of supply units results in degradation of their receipt/issue capability during the move. In addition, attrition of trucks, both at the maneuver unit and along the MSRs, degrades the ability of the CSS system to deliver supplies.

(b) Return-to-Duty. Although this module represents both the tactical CSS function of fix and CHS functions of patient evacuation and treatment, the Division CSS Analysis focused only on fix. Combat attrition and reliability failures generate the maintenance workload. The equipment maintenance play in the VIC model addresses three tasks: repair, recovery, and equipment evacuation. Three generic types of mechanics (automotive, armament, and helicopter) perform the repair functions. The model uses the number of maintenance man-hours (MMH) required to repair the specific weapon system to calculate the utilization rate for these mechanic types. A fixed delay time (96 minutes including round trip travel, hook-up, and drop-off) represents recovery operations in the model. Evacuation is dynamic. Operational evacuation vehicles make the appropriate pick-ups and travel on the MSR. A number of events to include combat activity, unit movement, and MSR congestion may degrade repair and evacuation activity. For example, repair unit movement degrades the unit's mechanic MMH availability by 50% while the respective unit is moving. Changes in evacuation distances due to unit movements and congestion on the MSRs degrade evacuation performance.

d. ***Definitions of Terms.***

(1) "Authorized" stockage. The maximum quantity of stockage that a given unit can have on hand at any given time. This quantity is a function of the number of available systems and the amount that can be carried either on the system or on organic support assets. "Authorized" stockage can vary among the time periods base on system availability.

(2) "Reorder Assessment Cycle." On-hand stockages are reviewed for each unit once an hour, unless otherwise noted. That is both CSS and maneuver units assessed their stockage status and reordered needed supplies at the end of each hour.

(3) "Standard Resupply." The term "Standard Resupply" represents the threshold at which a unit reordered supplies. The maneuver units generate an order for a supply type when the balance-on-hand (BOH) for that supply type is greater than 49% but less than 75% of the authorized quantity. The size of the order is the amount necessary to return the BOH to the unit's authorized quantity. "Standard Resupply" orders are shipped via ground transportation. When an order cannot be completely filled in the period in which it was requested, the unfilled portion is lost. There are no backorders or due-outs.

(4) "Emergency Resupply." The term "Emergency Resupply" represents a secondary threshold at which a unit reordered supplies. The threshold varied by scenario. In LANTICA 2, the maneuver units generate an "Emergency Resupply" order for a supply type when the BOH for that supply type is less than 50% of the authorized quantity. In NEA this threshold was set at 25%. The size of the order is the amount necessary to return the BOH to 50% of the unit's authorized quantity. "Emergency Resupply" orders are shipped via airlift. In the VIC model, "Emergency Resupply" is subject to three factors: the availability of stocks; the availability of helicopter support to provide airlift; and the hostile environment surrounding the maneuver unit. The last factor can be the most limiting. Helicopters will not provide lift to maneuver units that are under assault. If any one of the factors prohibits fulfillment of an "emergency resupply" request, that order will be routed for "standard resupply".

1.10. References and Related Studies.

a. *References.*

(1) *Joint Venture Campaign Plan,* (draft), TRADOC BLITCD, 14 March 1995.

(2) *The Five Year Joint Venture Analysis Plan*, TRAC, 25 April 1995.

(3) *Force XXI Division Operations Concept*, TRADOC Pam 525-71, March 1996.

(4) *CSS Operations in Support of Force XXI Division Redesign*, (final draft), CASCOM, September 1996.

(5) *The Force XXI Division Design Analysis: Phase II Study Plan*, TRAC, October 1996.

(6) *The JV CSS Capstone Analysis Study Plan*, TRAC, (draft), October 1996.

b. *Related Studies and Other Documents.*

(1) *Force XXI DDA - Phase I Final Report*, TRAC, 11 March 1996.

(2) *Force XXI DDA CSS CAMEX Final Report*, TRAC, September 1996.

(3) Force XXI, 4ID Division XXI CSS Structure Scrub, Council of Colonels Brief, 16 November 1996.

(4) *The Prairie Warrior (PW) 1996 AWE Final Study Report*, TRAC, 21 December, 1996.

(5) *Force XXI PW '96 AWE CSS Final Report*, TRAC, March 1997.

(6) *Velocity Management, A New Army Logistics Management Approach*, TRAC, March 1997.

(7) "Right-Size" DISCOM, General Hartzog Brief, CASCOM, 3 April 1997.

(8) *44 Tank Study*, TRAC, April 1997.

(9) *Front End Assessment (FEA) for CSS Operations at EAD* (draft), TRAC-Lee, May 1997.

(10) The CSS Enabler Functional Assessment (CEFA), TRAC, ongoing.

(11) Tactical Wheeled Vehicle Study, TRAC, ongoing.

CHAPTER 2
Results and Analysis
"Right Size" DISCOM Initiative

2.1. Background. The CG, CASCOM launched the "Right Size" DISCOM initiative in December 1996. The purpose of the initiative was to establish an analytical basis for determining the appropriate size and composition of the Force XXI CSS structure. Products of this initiative included a Force XXI IDD MOD HVY DISCOM structure, the CSS foundation for DDA - Phase III modeling, a CHD DISCOM for Division AWE experimentation, and input for Force XXI Table of Organization and Equipment (TOE) documentation. The process was an ongoing contract effort lead by Vector Research Incorporated (VRI). Key participants were the CASCOM Directors of Combat Development (DCD) for Ordnance (OD), Transportation (TC), Quartermaster (QM), and CSS; the Soldier Support Institute (SSI); the Army Medical Department (AMEDD); and the Aviation Center and School, DCD, Aviation Logistics (AVLOG). This Chapter of the DDA - Phase II Division CSS Analysis contains a discussion of the approach used and the Force XXI IDD MOD HVY DISCOM structure designed by the "Right Size" DISCOM Working Group.

2.2. Approach. This paragraph describes the CSS community's approach to determining the appropriate size and composition of the CSS structures required to support the alternative division CSS designs. Current Department of the Army (DA) approved Manpower Requirements Criteria (MARC) and consumption planning factors, combined with SME judgement, served as the basis for this analysis.

a. ***Assumptions***. All work was completed within the context of the assumptions listed below, along with those that underlie DDA - Phase II and the Division CSS Analysis.

(1) Maneuver units carry their weapon system load of ammunition and fuel, and nine Meals-Ready-to-Eat.

(2) Sustainment resources are mobile enough to anticipate requirements.

(3) The battle space allows the use of local haul planning factors.

(4) The Force XXI CSS design will not "salami slice" CSS missions by placing some components in the Division and the remainder in the Corps.

b. ***Constraints and Limitations.*** The personnel ceiling given for each alternative Force XXI CSS design was the primary constraint facing "Right Size" DISCOM participants. Force structure ceilings tempered unconstrained requirements. Likewise, the degree of Force XXI

concept and requirement representation reflected in MARC and consumption planning factors limited the analytics. That is, MARC and consumption planning factors available in early 1997 and used in this effort still included many AOE underpinnings.

c. ***Methodology***.

(1) The first step in the "Right Size" DISCOM methodology was to establish common rules-of-engagement and formats. The working group chose the Force XXI general patterns of operations, described in TRADOC Pam 525-71, *Force XXI Division Operations Concept*, March 1996, combined with "echelons of participation," as their analytic framework. Regardless of the mission, the basic pattern of operations for a Force XXI division will be to project the force, protect the force, gain information dominance, set the battle space conditions, conduct decisive operations, and sustain and transition to future operations. The second axis in this framework, "echelons of participation," identified the level of CSS participation in each pattern of operations. The CSS community's definition of each of the four "echelons of participation" follows:

(a) Direct participation includes those functions that contribute directly to the systems and forces engaged in an Army Force XXI pattern of Operations (Division Mission Essential Task List (METL)). These functions generally require location and timing concurrent with the operating force. Examples include emergency rearm and refuel operations, Battle Damage Assessment Repair (BDAR), combat medic operations, and combat vehicle recovery.

(b) Indirect participation includes those functions that provide rapid return of a weapon system, force or soldier to a fully operational status within the constraints of operational cycles. Examples include reestablishment of unit basic loads (UBLs) consumed during emergency rearm and refuel operations.

(c) Indirect support includes those actions necessary to return a Battlefield Operating System (BOS) to a fully operational status. Examples include restocking ammunition supply points (ASPs) and ammunition transfer points (ATPs) and operation of a Division Fuel System Supply point (FSSP).

(d) General support includes those actions necessary to achieve and maintain force readiness, which do not qualify for the above categories. Examples include personnel strength management, ammunition stockage management, and fuel materiel management.

(2) Each proponent's SMEs analyzed CSS responsibilities and workloads defined by the Force XXI concept and associated proponent doctrine. They used the framework for analysis described in the preceding paragraph. Space requirements were not considered during this stage of the analysis. Each proponent assessed the contribution of their respective functions to each Force XXI pattern of operations by assigning the function to one of the "echelons of participation" categories.

(3) The "Right Size" DISCOM working group assigned priorities based on each CSS function's contribution to the supported warfighter's mission. The weights depicted in Figure P2-

3 were applied to each function within each category (e.g., Project the Force - Direct Participation). These weights reflect three things: the warfighter's priorities, the "echelon of participation" associated with the given function, and the priority of each function within the given category. The Commander of the 4th ID, MG Kern, assigned the warfighter's weights for the patterns of operations. Sustain/Transition was not considered in the warfighter's weights since this is the pattern being evaluated. The "echelons of participation" received relative weights based on their definitions.

(Echelon of Participation Weight) (Warfighter's Weights)		4 Direct Participation	3 Indirect Participation	2 Indirect Support	1 General Support
1	Project the Force	(Functional Priority Weight) n --------→1			
2	Protect the Force				
3	Information Dominance				
3	Shape Battlespace				
3	Decisive Operations				
NA	Sustain/Transition				

FIGURE P2-3: Multi-Functional Prioritization Process

(a) Each function within each category (e.g., Project the Force - Direct Participation) was assigned an initial weight based on the inverse of the one-to-n list of functions in the given category. That is, given a category with 10 functions, then the weight of the top priority function would be 10 and that of the tenth priority function would be one. The primary drawback of this methodology is that categories with large numbers of functions skew the weights. In this case a significant problem did not occur because the number of functions in each category was approximately the same. A Colonel level SME Working Group integrated the proponent (excluding transportation) function priorities within the context of each Force XXI pattern of operations. For issues requiring a vote to achieve "consensus," each proponent had a single voting member. The CASCOM, DCD-CSS served as final arbiter for issues that could not be resolved by consensus or vote; however, a need for arbitration never arose. Once integrated, the working group overlaid transportation functions on those of the other proponents. For example, the function Emergency Rearm received a priority of seven within the Decisive Operations - Direct Participation category. Transport of Class V was treated as a subcategory of the Emergency Rearm function.

(b) The second phase of the weighting process determined "functional values" within each category by multiplying each function's initial weight by the commander's priority and the

"echelon of participation" weights. Many functions appeared in more than one category. The final mathematical weight for each was the summation of all values for the given function. Senior CSS leaders and proponent SMEs reviewed, adjusted and approved the mathematically weighted list of CSS functions.

(2) The functional proponents applied MARC factors to determine the type and number of spaces required to execute the CSS mission. The working group also used SME judgement and the prioritized function list to identify risks associated with a CSS force structure constraint of 4209. The final step in the "Right Size" DISCOM process was to propose methods of reducing those risks.

2.3. Discussion. The CSS community's assessment of the IDD MOD HVY DISCOM indicates that this structure is not robust enough to perform all support missions generated by its division. Based on today's full MARC, in 2003, an IDD MOD HVY DISCOM will need 4773 spaces to support the Force XXI IDD MOD HVY division. Technology, doctrine and training can resolve the shortfall; however, that is in the future. The CSS SMEs speculate that initiatives and enablers based on new technology will be the solution to cutting force structure. The initiatives and enablers are expected to increase the efficiency and effectiveness of the work being performed, reduce the mission execution time, and decrease personnel requirements in the DISCOM. The CSS community projects that fully funding and fielding the initiatives and enablers will reduce space requirements to the levels proposed for the Force XXI IDD MOD HVY DISCOM. This dependence on technology elevates the level of risk associated with providing the Force XXI division with adequate and "timely" CSS. During the 3 April 1997, "Right-Size" DISCOM, General Hartzog Brief, the CG, CASCOM presented the CG, TRADOC with the recommendations shown in Figure P2-4.

- Retain full MARC requirements for the near-term, pending insertion of enablers into the force.
- Support appropriate priorities and funding for expeditious integration of leap-ahead technologies, doctrine and training into the Division XXI CSS Force.
- Support Aviation community for DASB return.
- Support further "tinkering" with the IDD CSS design by 4th ID, 13th COSCOM and the CASCOM;
  - Reduced C2 requirement
  - New FSB/Maneuver Brigade relationships
  - New FSC/Maneuver Battalion relationships

FIGURE P2-4: 3 April 1997 "Right-Size" DISCOM, General Hartzog Brief, Recommendations

a. Table P2-1 outlines the final CG, CASCOM approved prioritized CSS function list. The four key functions, noted in bold print, appeared in only one category. As a result, the total weights for the respective functions were relatively low. The CG, CASCOM reprioritized these

low-weight functions based on their immediate contribution and importance to the successful completion of the warfighter's mission.

TABLE P2-1: CSS Functions Prioritized List

Function Title	Total Weight		Function Title	Total Weight
1. C2	1,174		26. Religious Support	188
2. EMT	460		27. Post ATM Ancillary Operations	186
3. BDAR	416		28. Cannibalization/Replacement	164
4. Patient Evacuation	372		29. Further Patient Evacuation	159
5. Recover Systems (Air/Ground)	328		30. Army Field Feeding System (Fwd)	142
6. Emergency Refuel	**60**		31. Transport/Reposition Rations	142
7. Operational Maneuver (TC)	**60**		32. Provide Personnel Replacements	141
8. Emergency Rearm	**48**		33. Transport Personnel Replacements	141
9. Transport Emergency Rearm	**48**		34. Component Repair (includes A/G electronics)	120
10. Conduct Advanced Trauma Management (ATM)	321		35. Tactical Relocation/Reorganization	108
11. Public Affairs	278		36. Combat Stress Control (CSC)	100
12. Log Planning Future Operations	274		37. Evacuation Maintenance	98
13. Refuel (non-emergency)	258		38. Transport Evacuation Maintenance (HET)	98
14. Maintenance Operations Management	252		39. Area Medical Support (Sick Call/Dental)	96
15. Base Maintenance Operations (Ground/Air/Med.)	230		40. Maintenance (Org/DS)	72
16. Conduct Mass Casualty Treatment	228		41. Preventive Medicine	72
17. Transport Mass Casualties	228		42. Return of Repaired Systems/ Components	66
18. Refit (Air/Ground)	225		43. Transport Class IX Replenishment	48
19. Transport NS CL IX/MA and Backhaul Unserviced	225		44. NEO/POW Transport	36
20. Rearm (non-emergency)	210		45. Transport MEDIVAC Overflow	33
21. Class V Redistribution (TC)	210		46. Optometry	32
22. FSSP	208		47. Postal Operations	16
23. Emergency Class VIII	192		48. Transport Div Mail	16
24. Resupply (all classes + H2O purification.)	192		49. Convoy Debrief	10
25. Transport/Lateral Redistribution of Supplies	192		50. Fund	6
			51. Data Management	3

b. The IDD MOD HVY DISCOM that contains 4,209 spaces was "constrained" by an IDD MOD HVY force structure ceiling of 15,820 spaces. Table P2-2 provides a summary level comparison between the proposed IDD MOD HVY DISCOM and a "Right Size" DISCOM representing unconstrained requirements for the 2003 timeframe. The 4th ID (the unit exercised

in the Task Force XXI AWE) identified 120 additional CSS positions (referred to as "OOPS") as being major omissions in the IDD MOD HVY DISCOM design. Most were FSC, HHC and Medical positions. These positions brought the size of the IDD MOD HVY DISCOM to 4,329 personnel. The CSS proponents applied MARC factors to produce a Full MARC - "De-modernized" or "Right Size" DISCOM. Based on full MARC, an IDD MOD HVY DISCOM needs 4,773 spaces to support the Force XXI IDD MOD HVY division. As noted in the constraints and limitations, the MARC factors used in these calculations include many AOE underpinnings. These calculations do not reflect expected space savings associated with CSS 2010 enablers and initiatives. The CSS community also acknowledged the need for a Division Aviation Support Battalion (DASB). Reestablishing a DASB similar to the one presently included in the AOE aviation support structure requires 150 spaces not included in the 4,209 IDD MOD HVY DISCOM structure.

TABLE P2-2: DISCOM Strength Comparison
IDD MOD HVY vs. "Right Size"

IDD MOD HVY DISCOM		IDD MOD HVY DISCOM Full MARC - "De-modernized"		Differences
Unit	Strength	Unit	Strength	
HHC, DISCOM	165	HHC, DISCOM	161	(4)
DSB	1,188	DSB	1,264	76
Sub-total	1,188	Sub-total	1,264	76
FSB, AR	970	FSB, AR	1,110	140
FSB, Mech	943 (2x)	FSB, Mech	1119 (2x)	176 (2x)
Sub-total	2,856	Sub-total	3,348	492
Total	4,209	Total	4,773	564

c. The prioritized list of CSS functions served to highlight risks associated with a 4,209 space IDD MOD HVY DISCOM. The 564-space difference shown in Table P2-2, combined with the 150 spaces needed to reestablish a DASB, raised CSS space requirements (714 spaces) back to AOE levels. When one associates spaces with the functions listed in Table P2-1, the 4,209 ceiling is reached at function number 30, Army Field Feeding System. All CSS functions numbered 30 and higher are above the 4,209 ceiling. Based on the priority list, the IDD MOD HVY DISCOM does not contain enough force structure to perform any of these functions.

d. The CG, CASCOM proposed several alternatives to the "Right Size" DISCOM force structure, assuming the DISCOM ceiling will remain at 4,209. These included: status quo, salami slicing functions, Active and Reserve Component (AC/RC) integration, balancing the combat force with the supporting force, EAD pass-back and taking advantage of technology. The CSS community pointed out that each alternative poses special risks. The SMEs stated that the status quo of 4,209 spaces significantly degrades division ground maintenance and the ability to support the aviation fight. The numbers of M1A2, M2 and M3 hull and turret mechanics included in the IDD MOD HVY CSS structure are insufficient to sustain pre- and post-operations requirements. Salami slicing breaks all CSS functions. Shifting functions from the AC to the

RC reduces flexibility and responsiveness during deployment and peacetime. The CSS structure must retain sufficient Compo 1 capabilities to meet early deployment and critical peacetime requirements. Balancing the combat with the support force by reducing the size of the maneuver battalion results in a marginal loss of firepower. The CG, CASCOM focused on the last two options (EAD pass-back and taking advantage of technology) as the most viable.

(1) Passing portions of the workload to EAD removes problems from Division but the requirement for the given function does not disappear. The CSS community proposed adding a Corps Support Battalion (Direct Support) (CSB (DS)) to the EAD force structure as a near-term solution for this problem. These units would handle that portion of the division's workload that exceed IDD MOD HVY DISCOM capabilities. To ensure adequate division support, these EAD units must be resourced at ALO 1. Figures P2-5 and P2-6 depict the proposed command and organizational structures for the CSB (DS). The exact structure and size for an IDD MOD HVY CSB (DS) was not determined; however, the potential size of this unit would be more than 300 spaces. The CSB (DS) would provide habitual support for a division. Many of its elements would be collocated with the supported division.

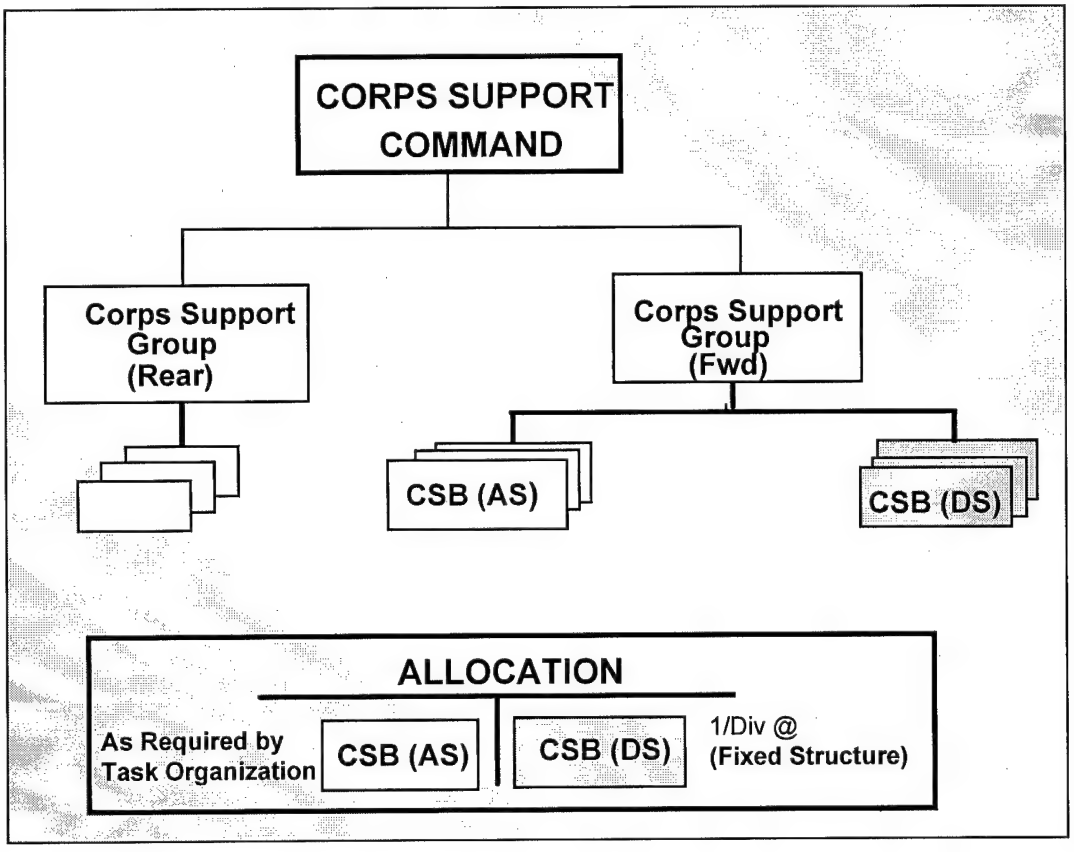


FIGURE P2-5: Proposed Command Structure for the CSB (DS)

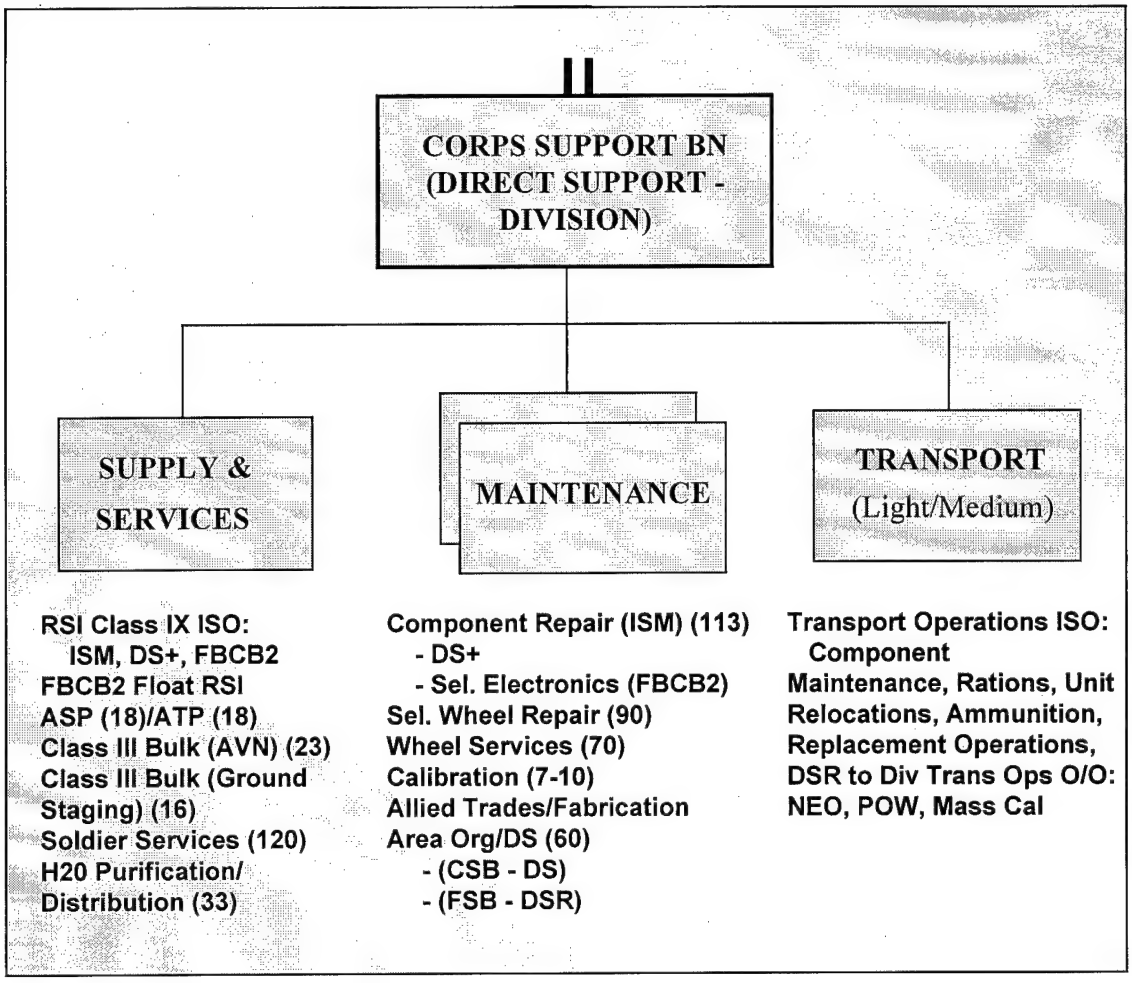


FIGURE P2-6: Proposed Organizational Structure for the CSB (DS)

(2) Technological enablers and initiatives are essential to the Force XXI concept. It is the CSS community's position that most CSS technological enablers offer no major requirements offsets or reductions in strength in the near-term. However, efficiencies associated with proposed enablers and initiatives are expected to reduce mission and space requirements over time. The lack of funded enablers and initiatives in the planning window for the Force XXI division design (1998 to 2010) increases the likelihood that proposed reductions in manpower requirements will not be feasible. In the far-term, funding for the CSS enablers and initiatives will be key to providing adequate and efficient support for the Force XXI division.

(a) The CSS community established a common definition of enablers and initiatives. These definitions serve as the basis for assessing the role and contribution of technology in providing support for the Force XXI division. The extract from CASCOM's 3 April 1997, "Right-Size" DISCOM, briefing for General Hartzog, defined enablers and initiatives as follows:

> ***Enabler*** *- doctrine, training, leadership, organizational, materiel, or soldier (DTLOMS) change that, when fielded, demonstrates and/or promises sufficiently*

increased efficiency in operation as to allow reductions in force structure or offset required capabilities that are currently unresourced".

Initiatives *- DOTLMS change for which there is currently no associated force structure reduction. Initiatives* ***may*** *transition to enablers as they are funded/resourced within a target window of consideration (Force 21, by 2010, etc.), reach maturity and demonstrate significant efficiencies as to allow consideration for force structure savings.*

(b) The CASCOM, 3 April 1997, "Right-Size" DISCOM Briefing for General Hartzog addressed force reductions that are expected to occur as a result of fielding CSS enablers and initiatives. Figure P2-7, an extract from that briefing, depicts currently identified CSS enablers. The question becomes, *"To what extent, and over what time frame, will enablers allow the Army to reduce divisional CSS personnel requirements from the current 4773 soldiers to a reduced, but supportable, Division XXI?"*

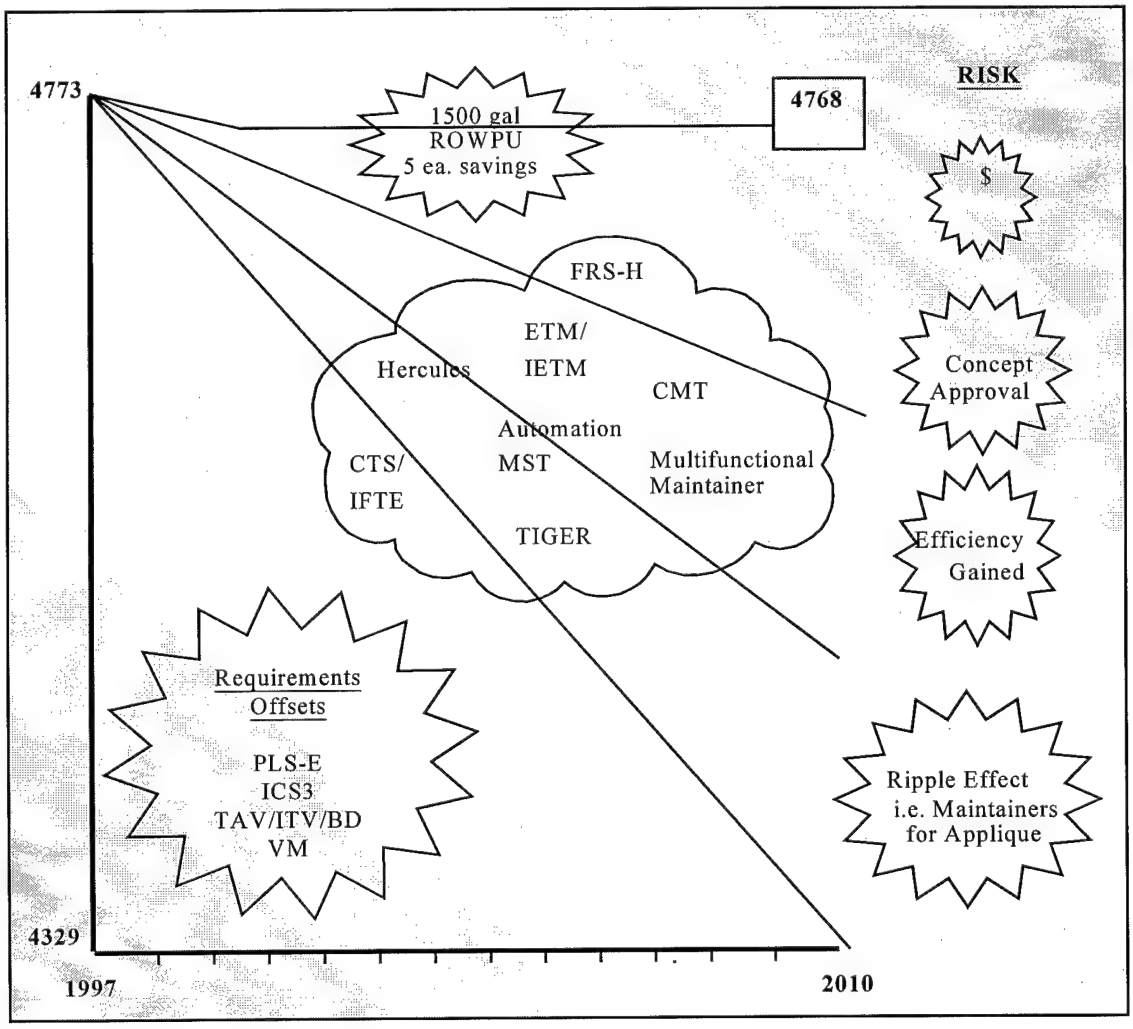


FIGURE P2-7: Force XXI DISCOM – Enabler Based Force Reductions

(c) The only enabler projected to provide near-term space savings was the 1500 gallon per hour Reverse Osmosis Water Purification Unit (ROWPU). Maintenance proponents project that several enablers and initiatives, which have space saving potential, will be in place by 2010. They include the Tactical Interactive Ground Equipment Repair (TIGER) Initiative, Contact Test Set (CTS)/ Integrated Family of Test Equipment (IFTE), Electronic Technical Manuals (ETM)/ Integrated ETM (IETM), Contact Maintenance Truck (CMT), Forward Repair System – Heavy (FRS-H), Hercules, and the multifunctional maintainer. Implementation of VM, BD, TAV and Intransit Visibility (ITV) is expected to offset some requirements. Other requirements offsets discussed included Palletized Loading System-Enhanced (PLS-E), Movement Tracking System (MTS) and automation initiatives such as Integrated Combat Service Support System (ICS3).

2.4. "Right Size" DISCOM DDA – Phase II Issue Insights. The "Right Size" DISCOM Initiative provided a forum for capturing CSS SME judgements and opinions on three of the four DDA – Phase II issues. Insights relating to Issue number one, which addresses the contribution of the CSS concept to the effectiveness of the force, are based on the results of modeling and are addressed in Chapter 3 of this report. The next three paragraphs provide a synopsis addressing each of the issues discussed by participants in the "Right Size DISCOM Initiative.

a. ***Effects of the Force XXI CSS concept on logistical operations.*** The CSS SMEs concluded that the Force XXI CSS concept is appropriate for logistical operations in support of a Force XXI division; however, the IDD MOD HVY DISCOM force structure reduces the CSS system's ability to complete these operations in the division.

(1) The kinds of functions necessary to execute Force XXI division CSS missions do not change drastically from those of AOE; however, the new operations concept drives us to reassess when and where these tactical support functions will take place. When employing the Force XXI operations concept, U.S. and coalition forces will rely heavily on deep fires. These forces will engage in fast paced battles, maneuvering on dispersed battlefields with long lines of communication. From a CSS perspective, anticipation and flexibility will be key to providing "timely" support. The pace of maneuver will dictate that resupply operations occur forward on the battlefield while repair operations move to the rear. The ability to conduct refuel-on-the-move (ROM) operations and to throughput Class V munitions to the maneuver elements will be essential to successful execution of the Force XXI concept. The maintenance focus will be to replace forward and to repair in the rear. Adequate recovery and evacuation assets, as well as, multifunctional mechanics will play an important role in any design that supports the Force XXI division.

(2) The Force XXI concept of operations and IDD MOD HVY DISCOM structure introduces a greater dependence on Corps CSS assets. A ceiling of 4,209 division CSS spaces, without the assurance of fully funded enablers and initiatives, makes it impossible to support the IDD MOD HVY division. Some of the functions currently performed by AOE division CSS elements must move to Corps. Additionally, reductions in the IDD MOD HVY force structure restrict the CSS system's ability to provide overall maintenance support. While the wheel vehicle maintenance structure is sufficient to sustain the highly mobile Force XXI division, the

ground maintenance structure contains fatal flaws in its ability to support Force XXI war fighting patterns. The number of M1A2, M2 and M3 hull and turret mechanics in the division are insufficient to sustain pre- and post-operations requirements. The introduction of Grizzly (a new engineer vehicle), combined with a reduction in the number of mechanics in the division caused an increase in the ratio of tracked systems to mechanics in the division. Additionally, AVLOG requires an agile support structure but the IDD MOD HVY AVIM element is located in the DSB, a fixed structure. Finally, the introduction of technological enablers could have secondary and tertiary effects on maintenance requirements. The enablers require support, which has not been considered in this effort.

b. ***The utility of CSS enabling technologies on the execution of the CSS concept.*** The primary tenets underlying the Force XXI CSS concept are SA and TAV. Enabling technologies provide the basis for both tenets. These technologies are necessary for the anticipation and flexibility inherent in the Force XXI CSS concept. They play a major role in the CSS system's ability to respond in a "timely" manner. The CSS SMEs expect enabling technology to aid in CSS force reduction by offsetting requirements. The SMEs project that fully funding enablers will reduce space requirements to the levels proposed for the Force XXI IDD MOD HVY DISCOM. This dependence on technology elevates the level of risk associated with providing adequate and "timely" CSS.

c. ***Optimization of the CSS concept and force design in support of Force XXI.*** The CG, CASCOM proposed several alternatives to the "Right Size" DISCOM force structure, assuming the DISCOM ceiling will remain at 4,209. The alternatives included: status quo, salami slicing functions, AC/RC integration, balancing the combat force with the supporting force, EAD pass-back and taking advantage of technology. None of these alternatives optimize the CSS force design. Each has inherent drawbacks. The SMEs focused their attention on passing portions of the workload back to EAD. The result is the proposed CSB (DS), an EAD unit designed to handle that portion of the division's workload which exceeds IDD MOD HVY DISCOM capabilities.

DDA Phase II
Division CSS Analysis
Final Report

CHAPTER 3
Results and Analysis
VIC CSS Modeling

3.1. Contribution of the CSS concept to the effectiveness of the force - Ability to support the offensive orientation of the Force XXI Division operations concept. Two scenarios, LANTICA 2 and NEA 2.0, provide the framework for examining this issue. Data generated during LANTICA 2 Base Case VIC gaming of these scenarios address the Force XXI CSS concept's and the IDD MOD HVY force structure's ability to support the Force XXI Division operations concept.

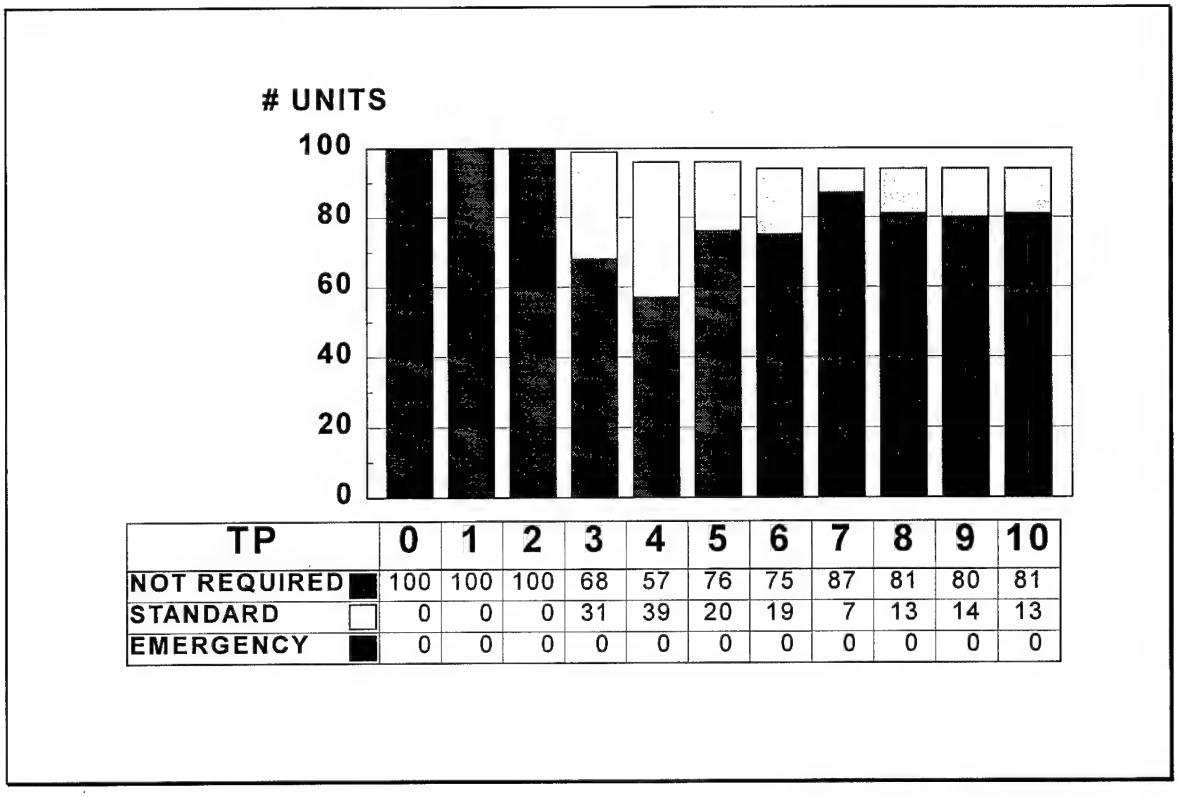
a. ***General.*** In both cases, the Force XXI CSS concept and the IDD MOD HVY division CSS force structure provide adequate Class III support for the Force XXI division and its supporting Corps slice. Similarly, the FSC design provides adequate Class V support for the Armor and Mechanized Infantry units. However, it is important to note that requests for FA munitions in support of division and Corps artillery units dominate Class V resupply requirements. Within the context of the LANTICA 2 scenario, Corps CSS elements have a persistent problem providing "timely" Class V resupply. While Class V resupply problems were considerably less during the NEA 2.0 scenario, some FA units still experienced zero balances during periods of peak operations. Although, the fidelity of the VIC model's maintenance representation limits detailed maintenance insights, automotive mechanic utilization rates within the DSB indicate a possible shortfall. The Force XXI CSS concept and IDD MOD HVY division CSS force structure need a more detailed evaluation at this level. All other maintenance support appears to be adequate although some shortfalls will arise during periods of peak operations.

b. ***LANTICA 2 Scenario.*** An assessment of the VIC output data produced by gaming the LANTICA 2 Scenario indicates that the Force XXI CSS concept and IDD MOD HVY division CSS force structure provide adequate Class III support for the Force XXI division but their abilities to provide Class V support are mixed. The division's Class V consumption rates in Armor and Mechanized Infantry units were not high enough to stress the FSC's ability to provide support. However, Corps CSS elements had trouble providing "timely" Class V resupply for the DIVARTY and Corps FA units supporting the division. Recovery and armament maintenance support, for the Force XXI division, were adequate at all levels; nevertheless, several FSCs experienced shortfalls in automotive maintenance man-hour availability during periods of peak operations. Continuous full utilization of available DSB automotive maintenance man-hours indicates that the number of automotive mechanics assigned to the IDD MOD HVY DSB may not be large enough to service the division's workload in a "timely" manner.

(1) Class III. All maneuver elements received Class III resupply in a timely fashion, although a few FSCs experienced minor short-term stock shortage problems. There were five occurrences where one of the FSCs did not have enough fuel on hand to immediately provide 100% of the Class III requested. Based on the consumption data in Table P2-3, we see that the CSS system shipped 87% and delivered 76% of the Class III requested by the maneuver units. The Class III resupply profile depicted in Figure P2-8 indicates that during any given 3-hour period approximately two-thirds of the maneuver elements did not consume more than 25% of their authorized Class III stockage. As a result, these units did not require resupply. The remaining units, which were refueled by "Standard Resupply," waited an average of six hours before their supply balances returned to greater than 75%. This did not adversely affect the mission of the supported battalions since the Class III stockage for each of these units remained at or above 50% of their authorization. "Emergency Resupply" was not necessary during Base Case gaming of this scenario. The quantity of fuel available in the maneuver units did not fall below 50% of the amount authorized for the given units.

TABLE P2-3: LANTICA 2 (Base Case)
Class III Consumption and "Standard" Resupply
(Gallons)

Time	Total Consumption	Ordered	Shipped	Received
H-hour	0	0	0	0
H+3	46,978	0	0	0
H+6	88,709	0	0	0
H+9	111,856	112,331	112,331	46,444
H+12	100,472	52,799	52,799	14,771
H+15	104,258	81,896	81,896	112,994
H+18	71,176	42,469	40,774	38,484
H+21	26,083	28,230	14,611	51,598
H+24	31,526	43,942	30,198	5,193
H+27	30,032	52,547	28,760	46,108
H+30	12,122	2,837	2,837	1,918
TOTAL	623,212	417,051	364,206	317,510
% of ordered shipped		87		
% of ordered received		76		



TP	0	1	2	3	4	5	6	7	8	9	10
NOT REQUIRED	100	100	100	68	57	76	75	87	81	80	81
STANDARD	0	0	0	31	39	20	19	7	13	14	13
EMERGENCY	0	0	0	0	0	0	0	0	0	0	0

FIGURE P2-8: LANTICA 2 (Base Case)
Class III Resupply for the Maneuver Units

(2) Class V. Several factors have the potential to hamper Class V resupply: a lack of transportation assets, stock shortages within the CSS units, distance between the CSS and the supported units, and the controlled status of munitions. In this scenario, the primary factor contributing to Class V resupply difficulties was transportation time, which has a direct link to distance factors and the controlled status of munitions. Problems with stock shortages and a lack of transportation assets were minor.

(a) The data in Table P2-4 shows a less than one percent difference between the amount of Class V ordered and the amount shipped by "Standard Resupply" (represented in VIC as ground transportation) in each three-hour period. The only exception was from H+25 to H+27 when this difference increased to approximately 15%. The availability of transportation assets and stockage allowed the CSS system to ship 94% of the tonnage ordered by the maneuver units through "Standard Resupply." Nevertheless, these units received only 50% of the short tons that they ordered, indicating that time and distance restricted the CSS system's ability to provide "timely" support.

(b) The large quantity of Class V provided through "Emergency Resupply" (represented in VIC as air transport) highlights the need for anticipatory logistics. The maneuver units received approximately one quarter of their ammunition resupplies through "Emergency

Resupply" channels. Stockage was below 50% of authorized levels when the units placed these orders. Further results of this wargame indicates that the respective unit basic loads, combined with "pull logistics," will not be sufficient to provide "timely" Class V support for the combat operation outlined in the LANTICA 2 scenario. This finding is based on the assumption that the Class V consumption rates and the LOC distances for the Force XXI division and its supporting Corps elements will reflect those shown in the VIC gaming of this scenario.

TABLE P2-4: LANTICA 2 (Base Case)
Class V Consumption and Resupply
(Short Tons)

Time	Total Consumption	"Standard Resupply"			"Emergency Resupply"
		Ordered	Shipped	Received	Ordered, Shipped & Received
H-hour	0	0	0	0	0
H+3	22	0	0	0	0
H+6	36	1	1	0	0
H+9	242	0	0	0	0
H+12	315	1	1	0	0
H+15	546	94	94	5	73
H+18	1,444	366	366	50	37
H+21	1,924	439	438	123	95
H+24	1,176	477	476	178	44
H+27	612	1,168	1,000	251	128
H+30	707	121	120	733	0
TOTAL	7,024	2,667	2,496	1,340	377
% of ordered shipped		94			
% of ordered received		50			

(c) All units began the scenario with stockage (BOH) equal to the amount authorized. As the scenario progressed, consumption depleted the stockage for the various munitions types. Munitions requiring replenishment by "Standard Resupply" are noted in Table P2-5, column 2. Columns 3 and 4, highlight munitions whose stockage in a particular maneuver unit dropped below 50% of that unit's authorization; thereby, initiating "Emergency Resupply" measures. Corps FA units and the DIVARTY experienced the most resupply difficulties. Stock levels for at least one munitions type within each FA key munitions category reached a zero BOH in one or more batteries at least once during the scenario. The Stinger and 120mm were the only other munitions requiring "Emergency Resupply" during the scenario.

TABLE P2-5: LANTICA 2 (Base Case)
Class V Resupply Requirements for Key Munitions

Key Munitions	"Standard Resupply"	"Emergency Resupply"	
	BOH = 50% to 74%	50% > BOH > 0%	BOH = 0
155MM	Yes	**Yes**	**Yes**
ATACMS	Yes	**Yes**	**Yes**
MLRS	Yes	**Yes**	**Yes**
HELLFIRE	No	No	No
LONGBOW	No	No	No
2.75RKT	No	No	No
PATRIOT	No	No	No
STINGER	Yes	**Yes**	No
120MM	No	**Yes**	**Yes**
25MM	Yes	No	No
LAW	No	No	No
TOWII	No	No	No

(d) This scenario's heavy reliance on deep fires caused FA consumption to stress the CSS system. Corps CSS units provided Class V throughput for two Corps Artillery Brigades that consisted of six MLRS and two 155mm self-propelled howitzer battalions. The ASPs also supported the DIVARTY that included two MLRS and nine 155mm self-propelled howitzer batteries. From H+13 until the end of the scenario, 155mm and MLRS munitions made up more than 90% of all Class V ordered by and shipped to the maneuver units.

⇒ None of the 155mm self-propelled howitzer batteries completely exhausted all of their munitions. However, all 155mm self-propelled howitzer batteries in the Corps (67th FA Bde) and six of the nine in the DIVARTY experienced stock levels that were below 50% of the authorized stockage for at least one munitions type. In approximately half of these instances, stockage was less than 10% of the authorized level for the given munitions. These units experienced numerous occurrences when their BOH at the end of a given 3-hour period was zero for more than one munitions type. Several batteries reached a zero balance for at least four of the 12 authorized munitions. From H+25 to H+27 the CSA and two supporting ASPs were unable to fully satisfy the maneuver unit's requests for specific munitions because of truck non-availability and stock shortages, respectively. Shortages at the maneuver units persisted from H+18 until the end of the scenario.

⇒ The FA MLRS batteries firing ATACMS munitions consumed 89% of the total number of rounds authorized for the scenario. Shortages in the maneuver brigades began as early as the first 3-hour period (H+1 through H+3) when A Battery, 3rd Battalion, 68th Brigade expended its entire stockage of extended range ATACMS-I munitions. During the final two 3-hour periods all units had a zero balance for three of the four ATACMS munitions used in this scenario. The controlled status of these munitions precluded resupply.

⇒ Stock levels reached a zero BOH in all FA batteries firing MLRS munitions (excluding ATACMS). Long distances between the maneuver units and their supporting CSS elements were the primary factor contributing to MLRS stockage problems. In addition, nonavailability of trucks at one ASP restricted MLRS resupply during one 3-hour period. Shortages persisted from H+18 until the end of the scenario. In general, once a unit experienced a zero balance for a given munition the condition continued to the end of the scenario.

(e) Aviation and Air Defense Artillery (ADA) consumption levels did not test the Force XXI CSS Class V resupply concept and force structure. These units did not consume more than 25% of their initially authorized stockage. As a result, Hellfire, Longbow, 2.75 Rocket, and Patriot munitions were not resupplied at any time during the 30-hour scenario.

(f) Although consumption rates in the Armor and Mechanized Infantry battalions triggered some resupply requests, the workload was not large enough to stress the FSC's ability to provide Class V support. Consumption of LAW and TOW II did not exceed 25% of the initial stockage for these munitions; therefore, resupply was not necessary. The 3rd Brigade, 2nd Battalion's consumption of 25mm munitions required only "Standard Resupply" measures since the lowest BOH reached in any given 3-hour period was 69% of its authorization. The BOH for Stinger never reached a zero level in any of the units. However, the consumption rate in one unit (the 1st Brigade, 2nd Battalion, Bradley Stinger Fighting Vehicle Platoon) triggered an "Emergency Resupply" request during one 3-hour period. Consumption of 120mm PGMM in both of the 1st Brigade's Mechanized Infantry Battalions caused zero balances for this munitions type. The units firing PGMM received some resupply from their respective FSCs but they consumed the quantities before the end of the given 3-hour period. Additionally, PGMM stock levels at the supporting FSCs reached zero BOH. Like ATACMS, 120mm PGMM is a controlled munition; thus, resupplies were not available.

(3) Maintenance. The fidelity of maintenance representations in VIC is not high enough to determine the exact type and quantity of equipment and mechanics needed. Yet, the data produced in this scenario provide substantial indicators as to the adequacy of the size of the force structure played. Given the maintenance workload generated during gaming of the LANTICA 2 scenario, the Force XXI CSS concept and the IDD MOD HVY force structure provided adequate recovery, evacuation, and armament mechanic support for the Force XXI division. However, the automotive mechanic utilization rates displayed in Table P2-6 highlight areas that warrant more in-depth analysis.

TABLE P2-6: LANTICA 2 (Base Case)
Mechanic Utilization Rates and Initial Strengths

Unit Name	Armament		Automotive		Helicopter	
	Utilization %	Initial Strength	Utilization %	Initial Strength	Utilization %	Initial Strength
10th CORPS	12	356	31	1,060	1	592
1 Bn., GS Bde., 10th Corps Avn	0	1	15	6	72	44
1 Bn., 1 Atk. Bde., 10th Corps Avn	0	1	14	6	13	21
2 Bn., 1 Atk. Bde., 10th Corps Avn	0	1	14	6	15	21
DSB (Gnd)	84	52	**100**	**78**	3	126
Div Cav Sqdrn (Gnd)	**100**	**5**	**100**	**44**		
Div Cav Sqdrn (Avn)	0	1	14	6	67	21
Div Avn Bde.	34	1	**100**	**6**	0	21
2nd Lift Bn., Div Avn Bde.	0	1	10	6	46	35
1 Atk. Bn., Div Avn Bde.	0	1	14	6	61	21
BSC, 1st Mech. Inf. Bde.	8	16	44	20		
FSC, 1st Bn., 1st Mech. Inf. Bde.	64	30	**100**	**55**		
FSC, 2nd Bn., 1st Mech. Inf. Bde.	47	30	74	55		
FSC, 3rd Bn., 1st Mech. Inf. Bde	77	30	64	70		
BSC, 2nd AR Bde	5	19	44	23		
FSC, 1st Bn., 2nd AR Bde	46	30	57	70		
FSC, 2nd Bn., 2nd AR Bde	79	30	**100**	**70**		
FSC, 3rd Bn., 2nd AR Bde	20	30	39	55		
BSC, 3rd Mech. Inf. Bde	13	16	**100**	**20**		
FSC, 1st Bn., 3rd Mech. Inf. Bde	**100**	**30**	**100**	**55**		
FSC, 2nd Bn., 3rd Mech. Inf. Bde	49	30	69	55		
FSC, 3rd Bn., 3rd Mech. Inf. Bde	54	30	**100**	**70**		

(a) Armament repair. Combat damage and Reliability, Availability, and Maintainability (RAM) failures incurred during this scenario did not overwhelm armament mechanic support. At all levels (DSB, BSC, and FSC) the number of MMHs associated with assigned armament mechanics was high enough to support the division's requirements. The armament mechanic MMH utilization rate at the end of any given 3-hour reporting period did not exceed 85% of the number mechanics assigned to the DSB. During periods of peak operations the Division Calvary (DIV CAV) experienced full utilization of the five armament mechanics assigned to support this element. Yet, the number of weapon systems waiting for armament repair was negligible at the end of the 30-hour scenario. The highest utilization rates at the BSC and FSC levels, were 13% and 79%, respectively. The only exception occurred between H+16 and H+18 when the 3rd Bde, 1st Mech. Inf. Bn required a 100% armament mechanic MMH utilization rate in the supporting FSC.

(b) Automotive repair. The automotive mechanics experienced some difficulty repairing the division's combat damage and RAM failure workload in a "timely" manner. Maintenance companies in the DSB, one BSC, four of the nine FSCs, and the DIV CAV experienced 100% utilization of assigned automotive mechanic MMHs at the end of one or more of the ten 3-hour reporting periods.

⇒ *DSB.* Data from the LANTICA 2 scenario indicates that 100% utilization of the DSB's automotive mechanics occurred from H+12 to the end of the 30-hour scenario. The primary factors underlying this 100% utilization rate were the pace of maneuver, Major Supply Route (MSR) congestion, rear area security, and the timing of Blue system combat damage. All of these factors except Blue system combat damage caused the DSB to move continuously. The VIC model represented this movement by degrading mechanic MMH availability at the DSB by 50%. Additionally, the surge of combat activity that occurred late in the scenario resulted in a backlog of 36 systems (six FA, 17 engineer, and 13 transportation vehicles) when the scenario ended. Given this sustained high utilization rate, one can conclude that the number of mechanics assigned to the DSB is the minimum required to support the division's workload. However, the fidelity of maintenance representations in the VIC model is not high enough to determine if a need for additional mechanics exists. A definitive assessment to determine the number of automotive mechanics necessary to service the DSB's workload will require more in-depth analysis than can be completed using pure VIC outputs.

⇒ *DIV CAV.* As noted in the discussion of the DSB, a more in-depth analysis than can be completed using pure VIC outputs would be required to assess the adequacy of the number of automotive mechanics assigned to support the DIV CAV. The 44 automotive mechanics assigned to support the DIV CAV experienced a 100% MMH utilization rate from H+12 until the end of the scenario. The primary factors underlying this utilization rate were the pace of maneuver and the timing of combat damage received by Blue systems.

⇒ *BSC.* The number of MMHs associated with automotive mechanics assigned to the BSC supported the division's requirements. Generally the BSC's automotive mechanics were never fully utilized at the end of any given 3-hour reporting period. The only exception occurred at the BSC supporting the 3rd Brigade during one surge of combat activity.

⇒ *FSC.* The data indicates that 55 automotive mechanics in a mechanized FSC and 70 in an armored FSC are adequate to support the workload generated by the Force XXI division executing this scenario except during peak operations. Four of the nine FSCs supporting maneuver Battalions engaged in this scenario experienced 100% utilization of assigned automotive mechanic MMHs at the end of at least one 3-hour period. These phenomena occurred in both mechanized and armor FSCs. During two 3-hour periods (H+16 through H+18 and H+22 through H+24), the pace of maneuver affected automotive mechanic MMH utilization in the FSCs supporting the 1st Brigade, 1st Mechanized Infantry Battalion; the 3rd Brigade, 1st Mechanized Infantry Battalion; and the 3rd Brigade, 3rd Armor Battalion. From H+27 through H+30, the 2nd Brigade, 2nd Armor Battalion experienced a surge of combat damage that resulted in a 100% mechanic MMH utilization rate. The intensity of combat also contributed to the high automotive mechanic utilization rate experienced by the FSC supporting the 3rd Brigade, 1st Mechanized Infantry Battalion.

(c) Recovery operations. With the two exceptions at H+3 and H+21, shown in Table P2-7, recovery operations serviced the workload generated during this scenario in a "timely" manner. For this data point, "timely" is defined as recovering any given weapon system within two time periods (six hours from the request for recovery assistance). Evacuation backlogs did not occur. Both recovery shortfall exceptions were the result of intense combat activity. The FSC supporting the 2nd Brigade, 2nd Armor Battalion experienced two reporting periods when the number of damaged weapon systems requiring recovery was greater than the number of systems that it could recover in the period. In both instances the 2nd Brigade, 2nd Armor Battalion's FSC virtually eliminated the backlog during the next period. From H+13 through H+15, the 3rd Brigade, 1st Mechanized Infantry Battalion and its supporting FSC were engaged in intense combat activity. The recovery vehicle availability rate in the FSC dropped to a low of 15%. As a result, a backlog of damaged weapon systems waiting recovery developed at the 3rd Brigade, 1st Mechanized Infantry Battalion. This backlog existed from H+15 until the scenario ended.

TABLE P2-7: LANTICA 2 (Base Case)
Recovery Backlogs

Time	2nd Bde, 2nd AR Bn		3rd Bde, 1st Mech. Inf. Bn	
	Weapon Systems Waiting	Recovery Vehicle Availability	Weapon Systems Waiting	Recovery Vehicle Availability
H+3	**9**	99	1	98
H+6	1	99	1	97
H+9	1	97	1	96
H+12	0	96	**8**	95
H+15	0	95	**13**	**15**
H+18	0	94	**12**	**16**
H+21	**9**	93	**11**	**16**
H+24	1	94	**9**	**24**
H+27	1	92	**7**	**23**
H+30	0	92	**4**	**57**

c. ***NEA 2.0 Scenario.*** Within the context of this scenario, the division's support requirements placed only minor stress on the CSS system. Class III consumption was not high enough to allow any assessment of the Force XXI CSS concept and IDD MOD HVY division CSS force structure. None of the units consumed more than 25% of their initial Class III authorizations. Likewise, the division's Class V consumption rates in Armor and Mechanized Infantry units were not high enough to trigger FSC support; but, Class V throughput from Corps was not "timely" during peak operations. Corps CSS elements encountered problems resupplying two of the seven FA battalions supporting the division. Stock shortages were the primary factor contributing to these resupply difficulties. Problems associated with a lack of transportation assets were minor. Finally, the capabilities outlined in the Force XXI CSS concept and IDD MOD HVY division CSS force structure adequately service the recovery, evacuation, and repair workload generated during the NEA 2.0 scenario.

(1) Class III. Table P2-8 shows Class III consumption during the NEA scenario. The division and its supporting Corps slice consumed 22,716 gallons of fuel. Further examination of the data indicate that Class III consumption within the maneuver units did not exceed 25% of any given unit's authorization. As a result, resupply was not necessary.

TABLE P2-8: NEA 2.0 Scenario
Class III Consumption

Time	Consumption (Gallons)
H+4	4,822
H+8	6,314
H+12	1,197
H+16	3,586
H+20	2,398
H+24	1,102
H+28	792
H+32	398
H+36	418
H+40	471
H+44	1,218
H+48	0
TOTAL	22,716

(2) Class V. The Force XXI CSS concept and the IDD MOD HVY force structure experience only minor difficulty supporting the Force XXI division played in the NEA 2.0 scenario. The data displayed in Tables P2-9 and P2-10 provide the resupply profile for Class V consumption and resupply. In NEA 2.0, as in the LANTICA 2, the Force XXI operational concept's heavy reliance on deep fires caused FA consumption to exercise the CSS system. Units firing ATACMS and other MLRS munitions used approximately three times their initially authorized stockage quantity. The requirement for FA resupply made up approximately 99% of all resupply requests. The CSS system did not experience difficulty responding to these requests. Differences between the amounts ordered and the amounts shipped were not significant. The CSS system shipped 96% of all orders. When the scenario ended at H+48 the maneuver units had received over 90% of all ammunition ordered. Additionally, "Emergency Resupply" (occurring in the NEA scenario when unit stock levels are less than 25% of authorizations) shipments accounted for a very small fraction of all deliveries. In spite of this performance, two FA battalions and one DIV CAV troop experienced zero stock levels at least once during the 48-hour scenario.

TABLE P2-9: NEA 2.0 Scenario
Class V Resupply Requirements for Key Munitions

Key Munitions Type	Initial State	Consumption		"Standard Resupply"	"Emergency Resupply"	
	Amount Authorized {Rounds}	Amount Used {Rounds}	Amount Lost {Rounds}	BOH = 25%-74%	25% > BOH > 0%	BOH = 0
155MM	22,464	7,046	119	Yes	No	No
ATACMS	162	474	1	Yes	**Yes**	**Yes**
MLRS	4,788	12,675	27	Yes	**Yes**	**Yes**
HELLFIRE	2,304	19	0	No	No	No
LONGBOW	2,304	187	5	No	No	No
2.75RKT	10,944	632	2	No	No	No
PATRIOT	128	11	0	No	No	No
STINGER	882	11	11	No	**Yes**	No
120MM	9,483	1,314	359	Yes	**Yes**	**Yes**
25MM	359,910	47	31,427	No	No	No
JAVELIN	275	0	5	No	No	No
LAW	1,287	0	25	No	No	No
TOWII	1,475	0	50	No	No	No

TABLE P2-10: NEA 2.0 Scenario
Class V Consumption and Resupply
(Short Tons)

Time	Total Consumption	"Standard Resupply"			"Emergency Resupply"
		Ordered	Shipped	Received	Ordered, Shipped & Received
H-hour	0	0	0	0	0
H+4	563	180	132	0	5
H+8	657	514	514	234	0
H+12	436	401	393	519	20
H+16	475	136	130	311	20
H+20	659	516	484	379	0
H+24	764	1,001	971	937	0
H+28	578	183	180	405	20
H+32	351	320	312	150	0
H+36	440	452	439	619	2
H+40	164	19	5	4	0
H+44	247	310	283	264	2
H+48	280	296	293	161	0
TOTAL	5,614	4,328	4,136	3,983	69
% of ordered shipped		96			
% of ordered received		92			

(3) Maintenance. The Force XXI CSS concept and IDD MOD HVY division CSS force structure provide adequate recovery, evacuation, and repair capabilities to support a Force XXI division executing the mission outlined in the NEA 2.0 scenario. Recovery and evacuation backlogs for major weapon systems do not occur during this scenario. With one exception, the amount of combat damage and RAM failures incurred during this scenario did not overwhelm mechanic support. The number of MMHs associated with assigned armament and automotive mechanics was high enough to support the division's workload. Mechanic utilization rates and the number of weapon systems waiting for repair were negligible at the end of the 48-hour scenario. The only exception was Corps support for ADA armament repairs. A shortage of armament MMHs caused low weapon system availability and a repair backlog for ADA systems.

3.2. Contribution of the CSS concept to the effectiveness of the force – Ability to support the Force XXI Division for reorganization for follow-on operations. The Extension, an excursion of the LANTICA 2 scenario, provided the basis for insights relating to the Force XXI CSS concept and IDD MOD HVY force structure's ability to support the Force XXI division for reorganization for follow-on operations. This excursion extended the LANTICA 2 Base Case from H+30 to H+54 (24 hours or eight additional 3-hour reporting periods). The primary reason for extending the LANTICA 2 Base Case was to allow the CSS system to prepare for follow-on operations by continuing its missions. NEA 2.0 did not require an extension because of the high end-state stock levels of this scenario. Close combat was suspended during the extension but Red and Blue artillery counter battery fires continued. These artillery fires had significant impacts on reorganization activities. The VIC model's protocols cause units under fire to relocate on the battlefield. While under fire and relocating these units suffer combat damage and RAM automotive failures that increase the maintenance workload. In addition, a maintenance unit under fire suffers 50 percent degradation of available mechanic MMHs while relocating. Finally, counter battery fires by Blue artillery units create additional Class V resupply requirements and RAM firepower failures. Data generated by this excursion provided insights in three areas: the length of time required to provide Class III and Class V resupply for the division and its supporting Corps CS elements; transportation asset availability; and the level of maintenance activity required to repair damaged weapon systems that were in maintenance at the end of base case gaming.

a. ***General.*** The Force XXI CSS concept and the IDD MOD HVY division CSS structure can support the Force XXI division and its supporting Corps elements for reorganization for follow-on operations in all areas except Class V resupply and DSB repairs. The quantity of munitions needed to support continuing counterbattery fires will hamper the supply and transportation system's ability to provide adequate FA Class V throughput. Additionally, DSB automotive mechanics were unable to eliminate or reduce their workload during the 24-hour reorganization period. The primary assumption underlying these conclusions is that the division's follow-on operations will require the same level of combat power as the initial mission.

b. ***Class III.*** Table P2-11 provides a comparison of Class III stockage and consumption during base case and extension gaming of the LANTICA 2 scenario. The end-state Class III

stockage status within the Force XXI division was at 88% of authorizations when the initial scenario ended. The stock level for fuel (88% vs. 84%) remained at essentially the same throughout the reorganization period. The impact on the Force XXI division's ability to complete a follow-on mission should be minimal. Stock levels in all active units were 50% or greater. Only 13% of the CSS units' Class III shipments were still on the road when the initial 30-hour scenario ended. These shipments arrived at the requesting units within nine hours. The 32,132 gallons of fuel consumed during the LANTICA 2 scenario 24-hour extension did not have a significant impact on resupply operations.

TABLE P2-11: LANTICA 2 (Base Case vs. Base Case Extension)
Class III Stockage & Consumption
(gallons)

	Base Case	24-Hour Extension
Initial Stockage	(H-hour)	(H+30)
Authorization	1,187,757	1,004,737
BOH	1,187,757	881,717
Percentage of Authorized on hand	100%	88%
Total Class III Consumption	(H-hour - H+30)	(H+31 - H+54)
Amount Used	607,370	32,132
Amount Lost	15,842	2,718
End State Stockage	(H+30)	(H+54)
Authorization	1,004,737	851,846
BOH	881,717	714,373
Percentage of Authorized on hand	88%	84%

c. ***Class V.*** Reviewed in isolation, the Force XXI CSS system was able to provide Class V resupply for the division and its supporting Corps CS elements. However, including requirements generated by counter battery fires, which occurred during the reorganization period, invalidates this observation. Supply and transportation units took 15 hours (five reporting periods) to replenish approximately 90% of the Class V stockage consumed by the maneuver units during the initial 30-hour operation. Yet, end-state stockage conditions, shown in Tables P2-12 and P2-13, indicate that Corps CSS elements were not able to restore FA Class V stockage to levels above 50% of authorizations. Stock levels for all munitions types remained at essentially the same. The primary factor contributing to this phenomenon was the requirement for FA munitions caused by continuing counter battery fires. A lack of transportation assets at the CSA and the ASPs, as well as, stock shortages at the ASPs prevented the CSS system from fully resupplying the division and its supporting Corps maneuver elements.

TABLE P2-12: LANTICA 2 (Base Case)
Class V stockage Summary

	Initial Stockage (H-hour)	Total Class V Consumption (30-hour Scenario)		End-State Stockage (H+30)		
Key Munitions	Amount Authorized (Rounds)	Amount Used {Rounds}	Amount Lost {Rounds}	Amount Authorized {Rounds}	BOH {Rounds}	Percentage of Authorized on hand
155MM	29,610	25,930	561	25,111	12,758	**51%**
ATACMS	486	432	0	476	54	**11%**
MLRS	13,554	9,966	26	11,193	4,115	**37%**
HELLFIRE	564	275	2	243	398	164%
LONGBOW	1,488	822	9	655	1,065	163%
2.75RKT	10,428	1,314	33	6,034	10,246	170%
PATRIOT	120	2	0	102	118	116%
STINGER	1,266	261	19	828	1,103	133%
120MM	13,420	658	103	11,445	12,460	109%
25MM	544,740	347	58,098	424,996	463,465	109%
LAW	2,419	0	24	2,321	2,350	101%
TOW II	2,030	0	68	1,537	1,962	128%

TABLE P2-13: LANTICA 2 (Base Case Extension)
Class V Stockage Summary

	Initial Stockage (H+30)	Total Class V Consumption (24-hour Extension)		End State Stockage (H+54)		
Key Munitions	Amount Authorized (Rounds)	Amount Used {Rounds}	Amount Lost {Rounds}	Amount Authorized {Rounds}	BOH {Rounds}	Percentage of Authorized on hand
155MM	25,111	24,071	365	25,074	11,887	**47%**
ATACMS	476	24	0	471	30	**6%**
MLRS	11,193	7,411	0	11,150	3,574	**32%**
HELLFIRE	243	0	0	232	398	172%
LONGBOW	655	29	0	633	1,050	166%
2.75RKT	6,034	0	0	5,959	10,246	172%
PATRIOT	102	0	0	102	118	116%
STINGER	828	27	1	803	1,107	138%
120MM	11,445	108	39	11,979	12,370	103%
25MM	424,996	1,000	3,277	443,056	462,557	109%
LAW	2,321	0	6	2,319	2,346	101%
TOW II	1,537	0	3	1,677	1,958	117%

(1) The 86 PLS trucks assigned to the CSA and the 9 PLS assigned to each ASP were not able to restore FA Class V stockage levels while simultaneously supporting counterbattery fires. In addition, distance factors associated with the LANTICA 2 scenario continued to curb resupply efforts. Truck shortages began as early as H+33. There were 35 occasions when a shortage of PLS prevented shipment of all requested munitions. Truck shortages at the CSA primarily affected the delivery of MLRS munitions to Corps FA units, while truck shortages at the ASPs affected MLRS and 155mm munitions deliveries to both Corps FA and DIVARTY units.

(2) Stock shortages at the ASPs also hampered resupply efforts. On 13 occasions, the CSS system was unable to fully comply with a FA unit's request for a given munition. The majority of unfilled requests were for the 155mm munitions.

(3) The Corp's and the DIVARTY's 155mm munitions status remained essentially unchanged. These units ended the initial 30-hour scenario with approximately 50% of authorized munitions on hand. The CSS units delivered all shipments (approximately 17 truckloads) of 155mm munitions that were on the road at the end of the initial 30-hour operation within 12 hours. In spite of this, FA units had less than 50% of authorized munitions on hand at the end of the 24-hour reorganization period. The 155mm howitzer batteries consumed an additional 24,000 rounds of munitions. Because of continuing consumption, Corps CSS elements were not able to return 155mm munitions stock levels to greater than 50% of authorizations. At the conclusion of reorganization activities, Corps artillery and the DIVARTY remained at zero balance for up to five munition types.

(4) Follow-on operations can expect minimal FA ATACMS support but this is not a CSS supply system issue. As a controlled munition, only limited quantities of ATACMS were assigned to the theater; therefore, resupply is not available. Corps MLRS (ATACMS) battalions supporting the Force XXI division fight ended the 30-hour scenario with only one of four ATACMS sub-munitions on hand. The 54 extended range ATACMS rounds remaining constituted 11% of authorizations for all ATACMS munitions. Additional examination revealed that these rounds were equally distributed among the three batteries in the 1st Bn, 67th FA Bde. During the 24-hour reorganization period, counterbattery fires consumed 24 of the remaining rounds, further reducing quantities on hand.

(5) The MLRS battalions faced the same resupply obstacles as the 155mm howitzer battalions. The Corps and DIVARTY ended the initial 30-hour scenario with 37% of authorized MLRS munitions (excluding ATACMS) on hand. The transportation system delivered the 74 truckloads of MLRS that were on the road at the end of the initial 30-hour operation within 15 hours. At the same time, the MLRS battalions consumed 7,411 additional rounds during the 24-hour extension. Because of the continuing consumption, resupply efforts did not have a significant impact on MLRS stockage levels. The MLRS units ended the reorganization period with 32% of their authorized munitions on hand. Approximately one-half of the Corps batteries were at zero balance for at least one munition type. Several units were not resupplied during the 24-hour extension. When the extended scenario ended at H+54, at least 37 truckloads of Class V were still on the road.

d. ***Maintenance.*** All components of the Force XXI CSS concept and IDD MOD HVY division CSS force structure, except the DSB, supported maintenance actions necessary to reorganize and prepare the Force XXI division for follow-on operations.

(1) Maintenance workload and mechanic availability. At the end of the initial 30-hour scenario, DSB mechanics had expended 465 automotive MMHs. An additional 638 MMHs was needed to complete automotive repairs on all vehicles that were still in maintenance. Rear area security, along with and continuing counter-battery requirements, had a significant impact on the DSB's ability to repair the major weapons systems. Maintenance unit movement degraded mechanic availability and resulted in maintenance overflow to Corps. Weapon systems and other vehicles evacuated included two 155 mm howitzers (Crusaders), two M9 Armored Combat Earthmovers (ACEs), two Armored Vehicle Launched Bridges (AVLBs), two medium tactical vehicles (MTVs), one combat engineer vehicle (CEV), one heavy equipment transporter (HET), one high mobility wheeled vehicle (HMMWV), and one light medium tactical vehicle (LMTV). When the reorganization period ended at H+54, the DSB still needed an additional 878 automotive MMHs to repair all damaged vehicles remaining. The DSB automotive mechanics were unable to eliminate or reduce their workload during the 24-hour reorganization period.

(2) Weapon system availability. Ninety-four of the 100 maneuver units (division and Corps) remained active at the end of the initial gaming of the LANTICA 2 scenario. The six combat ineffective units (three MLRS, two ADA, and one DIV CAV) will not be available to participate in follow-on operations. The VIC model redistributed their undamaged resources among the active units. Although the active units can participate in follow-on operations, not all of their weapon systems were available at the end of the initial 30-hour operation. Attrition and combat damage reduced weapon system availability in the active units. Attrited weapon systems are permanent losses and will not contribute to availability. Those systems receiving combat damage enter the maintenance system, are repaired, and returned to a unit. The discussion that follows addresses maintenance support for the following systems: tanks and Infantry Fighting Vehicles (IFVs), Future Scout Vehicles (FSVs), Crusaders, MLRS, helicopters, and ADA.

(a) The LANTICA 2 scenario began with an initial strength of 232 M1A2 tanks and 290 IFVs in the Armor and Mechanized Infantry Battalions. The DIV CAV units contained an additional 27 tanks. By the end of the initial 30-hour operation, one DIV CAV troop had been destroyed, leaving eight tanks available for redistribution. Attrition accounted for the loss of seven tanks and 20 IFVs. Twelve tanks and 32 IFVs were in maintenance. Only one unit, the 3rd Bde, 2nd Mech. Inf. Bn, had a tank availability level below 90%. During the extension gaming, tank availability in this unit went from 78% to 93% by H+36. The availability level for IFVs was below 90% in three active units. The repair system required 12 hours to return IFV availability in the active units to approximately 90%.

(b) The FSV suffered considerable combat damage. When the initial 30-hour operation ended, 6 systems had been destroyed and 22 were in maintenance. System availability for the FSV was below 90% in five active units. This phenomenon was due to a lack of crewmembers and not the result of mechanic nonavailability. The crew shortage problem persisted throughout the reorganization period.

(c) Corps 155mm self-propelled howitzer units ended the scenario at 70% of their initial strength, while division elements were at 77%. Five Corps systems and seven division systems were in maintenance when the initial 30-hour operation ended. Returning these systems would boost the overall strength for the155mm self-propelled howitzer to over 85%. The Force XXI CSS maintenance force structure in the DSB was able to accomplish this task within 12 hours after the initial operation ended.

(d) The MLRS will not require extensive maintenance support to prepare for follow-on operations. Corps MLRS systems firing ATACMS did not suffer significant attrition or combat damage. Units composed of these systems ended the 30-hour scenario at approximately 98% of their initial strength. Corps MLRS (excluding ATACMS) ended the scenario at 75% of its initial strength, but this did not place a significant workload on the maintenance system. The reduction in MLRS strength resulted from the combat ineffective status of three Corps MLRS batteries. Nine systems in these three batteries were destroyed, leaving 13 available for redistribution and five in maintenance. All other Corps MLRS batteries ended the 30-hour scenario at 100% strength. Division MLRS was at 88% of its initial strength.

(e) The number of helicopters in maintenance at the end of the 30-hour initial operation was not large enough to have a significant impact on system availability. During the initial operation, helicopter systems sustained a large amount of the attrition but little reparable combat damage. Aviation units lost one-third of their AH64s and one-half of their RAH66s. When the scenario ended, helicopter availability in the Corps, the Division, and the DIV CAV was 53%, 77% and 33%, respectively. Because of the high attrition rate, Class VII replacement will be necessary to restore Aviation unit strength to a level that would permit full support of follow-on operations.

(f) The Patriot battalions, the Avenger platoons and the Stinger platoons will not require extensive maintenance support to prepare for follow-on operations. Patriot battalions did not suffer significant weapon system attrition or combat damage during the gaming of the LANTICA 2 scenario. The division lost one of 12 Avenger and one of six Stinger platoons.

3.3. Effects of the Force XXI CSS concept on logistical operations. A comparison of data from the LANTICA 2 Base Case and the AOE excursion provide the basis for analyzing this issue. Forces modeled in both the Base Case and the AOE excursion use 2010 weapon system technologies. The AOE excursion is a regaming of the LANTICA 2 Scenario, which employs AOE concepts and force design to execute the combat and the CSS missions. This excursion changes three variables: the concept of operations, the division's force structure, and the CSS concept. The Force XXI concept of operations employs rapid maneuver for decisive operations and relies heavily on deep fires to accomplish the mission. As noted in the March 1996 CSS CAMEX, the Force XXI battle space is larger and LOCs are longer than those traditionally experienced by AOE forces. When compared to an AOE heavy division, the IDD MOD HVY force structure contains one less attack aviation battalion, one less engineer battalion and three additional reconnaissance companies. In the LANTICA II Scenario, the Force XXI division's accompanying Corps slice has two additional engineer companies that are not located in the AOE division's Corps slice. From the CSS perspective, modularity, multi-functionality and SA are the

basis of the concept and CSS force structure being designed to support the Force XXI division. This concept consolidates division support in the DISCOM. Table P2-14 provides a summary of proposed personnel strength changes between AOE and IDD MOD HVY DISCOMs. The IDD MOD HVY force structure eliminates the AOE Main Support Battalion (MSB) and consolidates AOE maneuver unit CSS personnel in the IDD FSB. The net result reduces the total number of support personnel in the division from 4,919 under AOE to 4,209 under the IDD.

TABLE P2-14: DISCOM Strength Comparison
AOE vs IDD MOD HVY

AOE DISCOM		IDD MOD HVY DISCOM		Differences
Unit	Strength	Unit	Strength	
HHC, DISCOM	214	HHC, DISCOM	165	49
MSB	1,117	DSB	1,188	
DASB	575			
Sub-total	1,692		1,188	504
FSB, AR	445	FSB, AR	970	
FSB, Mech.	434 (2x)	FSB, Mech.	943 (2x)	
Maneuver unit combat trains	1,700			
Sub-total	3,013		2,856	157
Total	4,919		4,209	710
SOURCE: 4ID DIV XXI CSS Structure Scrub Council of Colonels Brief, 16 Nov. 96				

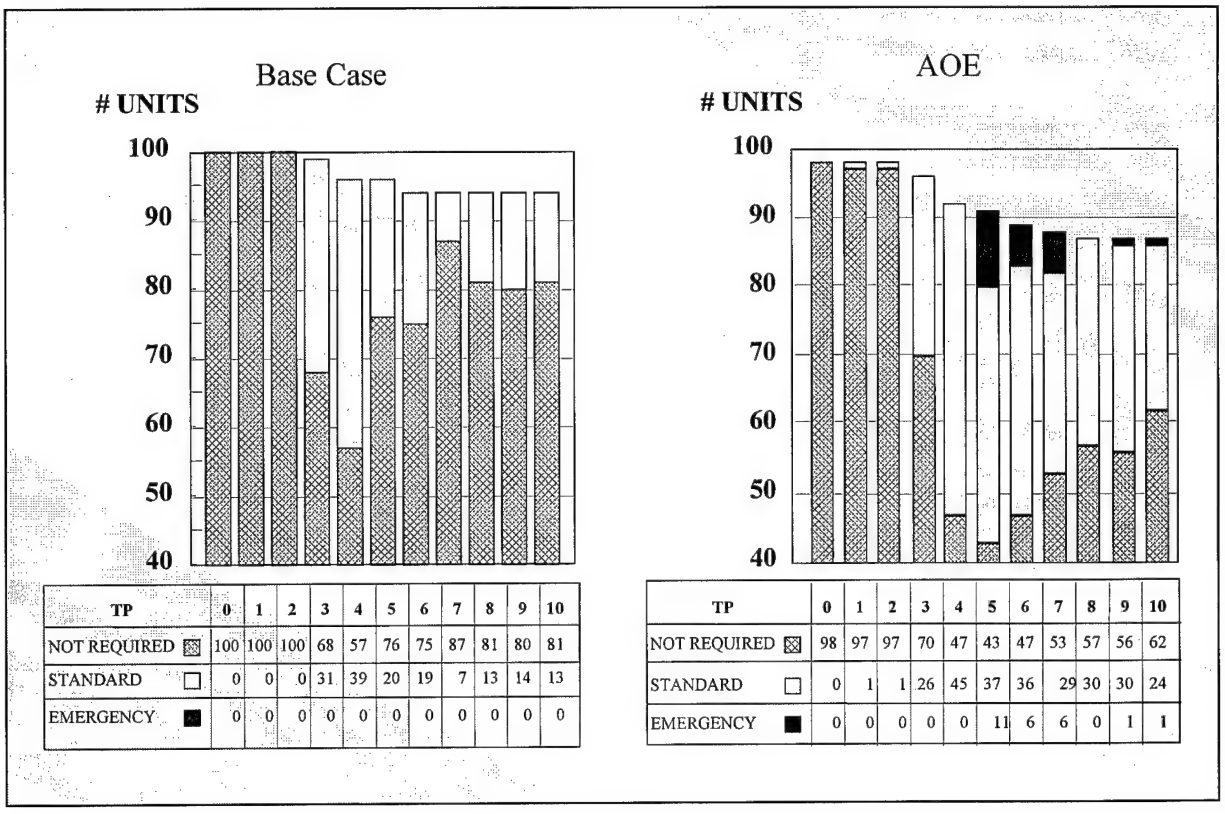
a. ***General.*** The Force XXI CSS concept had two observable impacts on logistical operations. First, implementing the Force XXI Class III concept reduced the risk of low fuel levels within FA and other Corps CS units while increasing the same risk within Armor and Mechanized Infantry units. Second, the Force XXI concept of Class V throughput to FA units was more effective than the AOE concept of supply point distribution. Fewer FA batteries experienced resupply problems although consumption of FA munitions increased considerably. Class V consumption in Armor and Mechanized Infantry units did not stress the CSS system. Therefore, this analysis could not produce insights as to differences between Force XXI and AOE Class V resupply concepts for these units. Under the Force XXI CSS concept the transportation system delivered more Class V to the maneuver units. From a maintenance perspective, variations in combat power between IDD MOD HVY and AOE forces heavily influenced the respective maintenance workloads. As a result, comparative insights are limited. The CSS system's performance during the gaming of the NEA 2.0 scenario excursion reinforces insights gleaned from LANTICA 2 gaming.

b. ***Class III.*** The data in Table P2-15 indicates that Class III support was essentially the same for both cases. Figure P2-9 provides a snapshot of this support from the maneuver unit's perspective. Under the Force XXI concept (Base Case), fuel balances for all units remained above 50% of authorizations throughout the LANTICA 2 scenario. On the other hand, there

were several occurrences during the AOE excursion when a unit's fuel balance dropped below 50%. Requests for "Emergency Resupply" occurred during five of the ten 3-hour reporting periods. At H+15 eleven units experienced stock levels below 50%. Using this data one can infer that the Force XXI CSS concept and the IDD MOD HVY force structure eliminate Class III resupply problems. However, further analysis indicates that the IDD MOD HVY force structure may in fact increase risks within Armor and Mechanized Infantry units. The number of occasions when a supporting unit did not ship the full quantity of Class III requested increased from two during the AOE excursion to five during the Base Case. In the AOE excursion, truck nonavailability was the primary reason that the transportation system did not ship all orders while stock shortages at the FSC lead to reduced shipments during Base Case gaming. Since FSC stocks are mobile, the increase in stock nonavailability reflects the reduction in fuel tankers at this level.

TABLE P2-15: LANTICA 2 (Base Case vs AOE Excursion)
Class III Consumption and Resupply Profile

	Base Case	AOE Excursion
Total Class III Consumption (Gallons)	623,212	602,277
"Standard Resupply" (Gallons)		
Ordered	417,051	301,443
Shipped	364,206	254,007
Received	317,510	227,735
Performance Statistics		
Stons ordered and shipped	87%	84%
Stons shipped and received	87%	90%
Stons ordered and received	76%	76%



TP	0	1	2	3	4	5	6	7	8	9	10
NOT REQUIRED	100	100	100	68	57	76	75	87	81	80	81
STANDARD	0	0	0	31	39	20	19	7	13	14	13
EMERGENCY	0	0	0	0	0	0	0	0	0	0	0

TP	0	1	2	3	4	5	6	7	8	9	10
NOT REQUIRED	98	97	97	70	47	43	47	53	57	56	62
STANDARD	0	1	1	26	45	37	36	29	30	30	24
EMERGENCY	0	0	0	0	0	11	6	6	0	1	1

FIGURE P2-9: LANTICA 2 (Base Case and AOE Excursion)
Class III Resupply Profile Comparison

c. ***Class V.*** The data depicted in Table P2-16, and Table P2-17 provides a comparative summary of the Class V consumption for Base Case and AOE excursion. The Force XXI operations concept's heavy reliance on deep fires caused a considerable increase in the consumption of FA and aviation munitions. The new consumption rates, combined with, the weight and bulk of these munitions, significantly increased the Class V workload. Yet, the CSS performance statistics in Table P2-17 indicate that the Force XXI CSS system provided significantly better support than the AOE CSS system.

TABLE P2-16: LANTICA 2 (Base Case vs AOE Excursion)
Class V Consumption by Munitions Type

Key Munitions	Initial Stockage (Rounds)		Amount Used (Rounds)		Amount Lost (Rounds)	
	Base Case	AOE Excursion	Base Case	AOE Excursion	Base Case	AOE Excursion
155MM	29,610	29,610	25,930	16,949	561	436
ATACMS	486	486	432	486	0	0
MLRS	13,554	13,554	9,966	6,553	26	23
HELLFIRE	564	720	275	202	2	1
LONGBOW	1,488	1,920	822	515	9	6
2.75RKT	10,428	13,680	1,314	129	33	25
PATRIOT	120	120	2	3	0	0
STINGER	1,266	1,368	261	81	19	17
120MM	13,420	13,960	658	117	103	251
25MM	544,740	487,800	347	1,551	58,098	30,698
AAWS-M		338		0		30
JAVELIN		72		0		8
LAW	2,419	2,350	0	0	24	28
TOW II	2,030	2,030	0	2	68	36

TABLE P2-17: LANTICA 2 (Base Case vs AOE Excursion)
Class V Stockage & Consumption Statistics

	Base Case	AOE Excursion
Total Class V Consumption (Stons)	7,023	4,770
"Standard Resupply" (Stons)		
Ordered	2,666	1,641
Shipped	2,495	1422
Received	1,341	444
"Emergency Resupply" (Stons)	377	351
Performance Statistics		
Stons ordered and shipped	94%	87%
Stons ordered and received	50%	27%

(1) The IDD MOD HVY (Base Case) FA units consumed approximately 35% more 155mm & MLRS munitions. Hellfire consumption increased 26% and Longbow consumption increased 37 % although the IDD MOD HVY force contains one less attack helicopter Bn than

the AOE force. Likewise, consumption of Stinger, 120 mm, and 2.75 rocket was at least 50% more than in the AOE excursion. The only exceptions to the pattern of increased consumption were ATACMS and 25mm munitions. Consumption of these munitions decreased by 13% and 347% respectively. The net effect of these changes was a 32% increase in Class V tonnage consumed.

(2) Increased consumption associated with Force XXI concepts did not reduce the resupply system's performance as shown in Table P2-17. The CSS system delivered 50% of the short tons of Class V ordered during the Base Case and only 27% of the short tons ordered during the AOE excursion. The AOE units faced over twice as many incidents when FA batteries experienced Class V resupply problems because of truck shortages. The five PLS trucks assigned to each FA 155mm battery were unable to fully support their unit's resupply requirements. All requested munitions were not shipped to the 155mm self-propelled howitzer batteries. Truck shortages hampered resupply operations for nine hours (from H+19 to H+27). In contrast, truck shortages hampered Corps resupply operations for only one 3-hour period during Base Case gaming.

d. ***Maintenance.*** The resolution of maintenance play in the VIC model does not provide enough fidelity and discrimination between the AOE and the Force XXI CSS concepts to allow an in-depth assessment of differences between their impact on logistical operations. However, a comparison of the data generated by the Base Case and the AOE excursion provides the general insights discussed below.

(1) Neither force experienced a serious shortage of armament mechanics during the scenario gaming. The IDD MOD HVY force stressed automotive mechanic support during periods of peak operations. Five of the nine FSCs experienced a 100% utilization rate for automotive mechanics at some time during the scenario. None of the AOE FSBs reached full utilization at any time in AOE excursion. When the Base Case and AOE excursion gaming ended at H+30 there were no significant differences in the size of the workloads remaining.

(2) Variations in combat power and unit survivability between IDD MOD HVY and AOE forces confounded maintenance performance data and hampered comparisons. Although both forces accomplished the mission, there was some indication that the IDD MOD HVY force structure increases the risk of catastrophic kills and combat damage. When looked at individually, major weapon system losses were 17% higher and the total MMH workload was 9% greater for the IDD MOD HVY force. Yet, as battalion elements, the IDD MOD HVY force proved to be more survivable than the AOE force. The number of combat ineffective units at the end of the 30-hour scenario was cut in half from 11 in the AOE excursion to six in the Base Case.

3.4. The utility of CSS enabling technologies on the execution of the CSS concept and the dependencies/risks associated with an unexpected loss of any of the CSS enablers. The analytical basis for insights relating to this issue is a comparison of output from the LANTICA 2 Base Case and two excursions, the Alternative and LANTICA 2 - Near Term. The Base Case is assumed to implicitly represent CSS enabling technologies since the computer transfers most

information instantaneously. The Alternative is a replay of the LANTICA 2 Base Case. It employs Force XXI combat and CSS concepts and the MOD HVY IDD force structure. This excursion portrays the loss of SA and TAV between the CSS elements by changing the VIC model's reorder assessment time between Blue CSS elements from one-hour (the BC) to 12-hour intervals (the Alternative). That is, during Alternative gaming CSS units assess their stockage status and reorder needed supplies at 12-hour intervals. The maneuver element's resupply procedures did not change from those employed in the base case run. These units continue to assess their stockage status and place orders hourly. Since the reorder assessment time among CSS units was the only parameter changed, insights gleaned from a comparison of Base Case and Alternative data focus only on resupplying Class III and V. Direct impacts on maintenance activities should be minimal because the model plays Class IX operations implicitly. The LANTICA 2 - Near Term excursion addresses the impacts of changing technology within the combat and CS units. This excursion retains the Force XXI concept and MOD HVY IDD force structure while using 2003 weapon system technology to execute the combat mission.

a. ***General.*** The CSS enabling technologies provide SA and TAV, the primary tenets of the Force XXI CSS concept. These technologies allow the CSS system to adequately support the fast paced battle dictated by the Force XXI operational concept. The pace of the battle and consequently, consumption was greater in the base case runs than in the excursions. The Force XXI CSS concept and the IDD MOD HVY force structure, with enabling technologies, supported these higher consumption rates. Class III resupply data indicates that CSS enabling technologies reduced Class III resupply risks within the maneuver units. Conversely, an unexpected loss of the CSS enablers lengthens the resupply waiting period and lowers fuel balances. The CSS system, with enablers, experienced difficulty providing Class V resupply. A loss of CSS enablers exacerbates this problem. However, limited CSS enabler representation in the VIC model restricted in-depth analysis of this issue. Several other CSS analyses are ongoing. They include Joint Venture Capstone CSS Analysis, CEFA, Task Force 21 AWE CSS Analysis, and Division AWE CSS Analysis. Each of these study efforts will contain further insights regarding the utility of CSS enablers and risks associated with their unexpected loss.

b. ***Class III.*** Table P2-18 and Figure P2-10 provide a comparative summary of the Force XXI division's Class III consumption and resupply activity for the LANTICA 2 Base Case and the two excursions noted above. Comparing Base Case and Near Term excursion data shows that differences among 2003 and 2010 combat technologies had little impact on the Class III workload. The presence of CSS enablers had at least two positive impacts. The average time spent waiting for resupply was 6 hours in the Base Case, which represented the presence of enablers. None of the maneuver units in the Base Case experienced fuel stockage levels below 50% at any time during the scenario. Conversely, the risk associated with the unexpected loss of a CSS enabler potentially increases resupply time and possibly contributes to lower fuel balances in the maneuver units. From the CSS perspective, SA does not have a significant impact on the total quantity of Class III received by the maneuver units. Units in the Base Case actually received a smaller percentage of total orders (76%) than units in the Alternative (91%) and those in the Base Case – Near Term (83%).

TABLE P2-18: LANTICA 2 (Base Case, Alternative, and Base Case - Near Term)
Class III Consumption and Resupply Summary

	Base Case (1-hour Reorder Assessment Interval)	Alternative (12-hour Reorder Assessment Interval)	Base Case- Near Term (1-hour Reorder Assessment Interval)
Total Class III Consumption (Gallons)	623,212	618,838	629,740
"Standard Resupply" (Gallons)			
Ordered	417,051	357,313	418,494
Shipped	364,206	329,415	362,550
Received	317,510	326,916	346,828
Performance Statistics			
Average time lapse before stock levels return to > 75%	6 hours	8 hours	11 hours
Gallons ordered and shipped	87%	92%	87%
Gallons ordered and received	76%	91%	83%

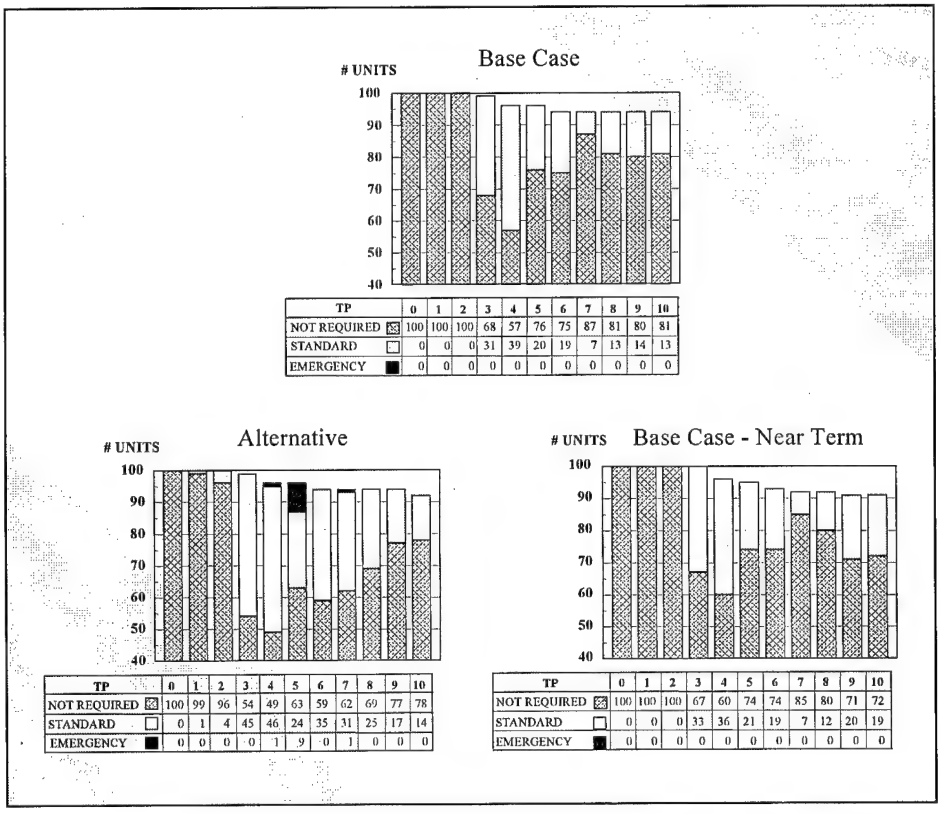


FIGURE P2-10: LANTICA 2 (Base Case, Alternative, and Base Case - Near Term)
Class III Resupply Profile Comparison

a. ***Class V.*** A comparison of the data extracted from these model runs indicates that the availability of CSS enabling technologies will reduce Class V resupply risks. Changing technology within the combat and CS units resulted in tradeoffs among the types of munitions consumed. The Base Case, which employs 2010 weapon system technology, used considerably more 155mm and ATACMS munitions. This increased consumption of FA munitions placed additional pressure on the Class V resupply system. Nevertheless, the CSS system performed better during the Base Case (with enabling technologies) than it did during the Alternative excursion. The need for Class V "Emergency Resupply" declined when enablers were present (Base Case). Since "Emergency Resupply" requests occur when stock levels fall below a predetermined threshold (50% for the LANTICA 2 scenario and 25% for the NEA 2.0 scenario), this figure serves as a measure of risk in the maneuver units. In addition, the total amount of ammunition received by "Standard Resupply" increased approximately 20 percent, even though the total quantity shipped did not change substantially. See the comparative summary provided in Table P2-19.

TABLE P2-19: LANTICA 2 (Base Case, Alternative, and Base Case - Near Term)
Class V Consumption and Resupply Summary

	Base Case (1-hour Reorder Assessment Interval)	Alternative (12-hour Reorder Assessment Interval)	Base Case- Near Term (1-hour Reorder Assessment Interval)
Total Class V Consumption	7,024	6,582	5,864
"Standard Resupply" (Stons)			
Ordered	2,667	3,010	1,968
Shipped	2,496	2,458	1,962
Received	1,340	919	1,269
"Emergency Resupply" (Stons)	377	445	492
Performance Statistics			
Stons ordered and shipped	94%	82%	99%
Stons ordered and received	50%	31%	65%

CHAPTER 4
Conclusions and Recommendations

4.1. Contribution of the CSS concept to the effectiveness of the force.

a. ***Ability to support the offensive orientation of the Force XXI Division operations concept.*** The Force XXI CSS concept and the IDD MOD HVY division CSS force structure provide adequate Class III and Class V support for the Force XXI division and its supporting Corps slice. The FSC design provides adequate support for the Armor and Mechanized Infantry units. However, it is important to note that requests for Class V FA munitions in support of division and Corps artillery units dominate Class V resupply requirements. Within the context of the LANTICA 2 scenario, Corps CSS elements have a persistent problem providing "timely" Class V resupply. While Class V resupply problems were considerably less during the NEA 2.0 scenario, some FA units still experienced zero balances during periods of peak operations. Although, the fidelity of the VIC model's maintenance representation limits detailed maintenance insights, automotive mechanic utilization rates within the DSB indicate a possible shortfall. The Force XXI CSS concept and IDD MOD HVY division CSS force structure need more detailed evaluation at this level. All other maintenance support appears to be adequate although some shortfalls will arise during periods of peak operations.

b. ***Ability to support the Force XXI Division for reorganization for follow-on operations.*** The Force XXI CSS concept and the IDD MOD HVY division CSS force structure can support the Force XXI division and its supporting Corps elements for reorganization for follow-on operations in all areas except Class V resupply and DSB repairs. The quantity of munitions needed to support continuing counterbattery fires will hamper the supply and transportation system's ability to provide adequate FA Class V throughput. Additionally, DSB automotive mechanics were unable to eliminate or reduce their workload during the 24-hour reorganization period. The primary assumption underlying these conclusions is that the division's follow-on operations will require the same level of combat power as the initial mission.

4.2. Effects of the Force XXI CSS concept on logistical operations. Insights gleaned from the "Right Size" DISCOM Initiative and the results of VIC gaming provide the basis for analyzing this issue. From both the Class III and Class V perspectives, the rapid maneuver on a dispersed battlefield, coupled with reduced resources within the division, resulted in a greater reliance on EAD support. This raises concern over future ALO requirements and resourcing of EAD CSS assets since the Division CSS Analysis assumes that corps support will be fully resourced.

a. ***Right Size" DISCOM Initiative***. The CSS community concluded that the Force XXI CSS concept is appropriate for logistical operations in support of a Force XXI division.

However, the IDD MOD HVY DISCOM force structure reduces the CSS system's ability to complete logistical operations in the division area. The Force XXI concept of operations and IDD MOD HVY DISCOM structure introduces a greater dependence on Corps CSS assets. A ceiling of 4,209 division CSS spaces, without the assurance of fully funded enablers and initiatives, makes it impossible to support the IDD MOD HVY division. Based on the MARC planning factors available in the early 1997 timeframe, some of the functions currently performed by AOE division CSS elements must move to Corps.

b. ***VIC CSS Modeling.*** The results of gaming showed two observable impacts on logistical operations. First, implementing the Force XXI Class III concept reduced the risk of low fuel levels within FA and other Corps CS units while increasing the same risk within Armor and Mechanized Infantry units. Second, the Force XXI concept of Class V throughput to FA units was more effective than the AOE concept of supply point distribution. Fewer FA batteries experienced resupply problems, although consumption of FA munitions increased considerably. Class V consumption in Armor and Mechanized Infantry units did not stress the CSS system. Therefore, this analysis could not produce insights as to differences between Force XXI and AOE Class V resupply concepts for these units. Under the Force XXI CSS concept the transportation system delivered more Class V to the maneuver units. From a maintenance perspective, variations in combat power between IDD MOD HVY and AOE forces heavily influenced the respective maintenance workloads. As a result, comparative insights are limited. The CSS system's performance during the gaming of the NEA 2.0 scenario excursion reinforces insights gleaned from LANTICA 2 gaming.

4.3. The utility of CSS enabling technologies on the execution of the CSS concept. Although not explicitly modeled in the constructive simulations, the CSS enablers are an essential part of the new CSS concept. The CSS enabling technologies provide SA and TAV, the primary tenets of the Force XXI CSS concept. These technologies allow the CSS system to adequately support the fast paced battle dictated by the Force XXI operational concept. The CSS units must be able to maintain situational awareness, monitor status in near real time, anticipate requirements and respond rapidly on a highly dispersed battlefield. Failure to fully field the key CSS enablers will limit the ability of CSS units to do this, perhaps to the point of making the entire concept infeasible.

a. ***VIC CSS Modeling.*** A comparison of the results of Base Case and the Alternative excursion gaming indicates that the Force XXI CSS concept and the IDD MOD HVY force structure, with enabling technologies, supported higher consumption rates although short-term supply shortages occurred. The absence of instantaneous knowledge within the CSS arena contributed to the duration of these supply shortages. An unexpected loss of the CSS enablers lengthened the resupply waiting period and lowered fuel balances. From a Class V perspective, the CSS system, with enablers, experienced difficulty providing Class V resupply for FA units. A loss of CSS enablers exacerbated this problem.

b. ***Other Studies***. Additionally, several other Force XXI CSS analyses were conducted within the same timeframe as the DDA. They include the JV Capstone CSS Analysis, CEFA, Task Force 21 AWE CSS Analysis, and Division AWE CSS Analysis. Each of these study

efforts contains further insights regarding the utility of CSS enablers and risks associated with their unexpected loss.

4.4. Optimization of the CSS concept and force design in support of Force XXI. Because of the fidelity of the VIC model and the maturity of the CSS concept, SME judgement provided the only basis for addressing this issue. The CSS SMEs participating in the "Right Size" DISCOM Initiative proposed several alternatives to the IDD CSS force structure, assuming the DISCOM ceiling will remain at 4,209. The alternatives included status quo, salami slicing functions, AC/RC integration, balancing the combat force with the supporting force, EAD pass-back and taking advantage of technology. None of these alternatives optimizes CSS support. Each has inherent drawbacks. The SMEs focused their attention on passing portions of the workload back to EAD. The result is the proposed CSB (DS), an EAD unit designed to handle that portion of the division's workload which exceed IDD MOD HVY DISCOM capabilities.

Force XXI
DDA Phase III

Division CSS Analysis

DDA Phase III
Division CSS Analysis
Final Report

CHAPTER 1
Introduction

1.1. Purpose. Division CSS analysis completed during DDA - Phase III considered the supportability of the three candidate division structures approved for analysis by the CG, TRADOC in May 1997. This analysis assesses each CSS design in the context of the Force XXI Division Operations Concept and compares their relative performances. Insights gleaned from DDA - Phase III Division CSS Analysis address the overarching JV issue # 2: "**How does the new CSS concept contribute to the effectiveness of the force?"** These insights, along with earlier insights documented in DDA Phases I and II, contributed to TRAC's assessment of this issue.

1.2. Background. The DDA - Phase I Division CSS analysis consisted of purely qualitative insights gleaned from SME surveys and CSS planning factor calculations. At the end of this phase in December 1995, the CG TRADOC chose the IDD for further analysis and experimentation. The second phase of DDA was conducted from January 1996 through May 1997. This phase included both qualitative and quantitative analyses. Insights from DDA - Phase II, the Task Force XXI AWE, and CASCOM's "Right Size" DISCOM initiative pointed to possible deficiencies in the proposed IDD. Additionally, further guidance capped the overall end strength of the Force XXI Division at 15,000. Emerging insights and the end-strength cap established a need for additional analysis. During May 1997, the CG, TRADOC approved three new division designs (CHD, STK, and BDT) for further analysis and experimentation.

1.3. Scope. The DDA - Phase II study issues were carried over for DDA - Phase III analysis. The third phase of the DDA continued to focus on the CSS concept's ability to support the offensive orientation of the Force XXI Division operations concept. Phase III analysis addressed the three candidate division designs noted in paragraph 1.2 above. The basis of each design is an objective force employing 2010 technology. Output from the CSS modules of the VIC model provided the analytical basis for this assessment.

1.4. Concept and Force Structure. As noted in DDA - Phase II, the Force XXI division operations concept, described in TRADOC Pam 525-71, *Force XXI Division Operations Concept*, March 1996, serves as the foundation for analyzing all proposed organizational designs for the Force XXI division. The basis of each candidate Force XXI design is an objective force employing 2010 technology. A graphic depiction and a brief overview of the candidate designs examined in Phase III (CHD, STK, and BDT) follow. The highlighted section in each figure represents the division's CSS structure, which is the focal point of the DDA - Phase III Division CSS analysis. The combat, CS and CSS augmentation available from corps differed among the scenarios because of tailoring for the specific warfighting conditions. See the DDA – Phase III main report for a detailed description of the force structures modeled.

a. ***The CHD Design***. This design is a modification of the IDD, selected by the CG TRADOC in December 1995 and evaluated in DDA - Phase II. There are 15,071 personnel in the CHD Mechanized Infantry variant as shown in Figure P3-1. The CHD structure is similar to that proposed for the IDD with three major exceptions. First, the maneuver battalions are built as three-company, armor and mechanized infantry combined arms battalions (CABs). Second, the CHD eliminates an engineer group headquarters. Finally, the CHD DISCOM differs from that of the IDD. The CHD DISCOM, with 4,321 personnel, is larger than that of the IDD. This DISCOM includes a DASB separate from the DSB. Engineer Support Platoons, located in the BSC of the FSB, replace the CSS assets previously located in the Engineer battalion.

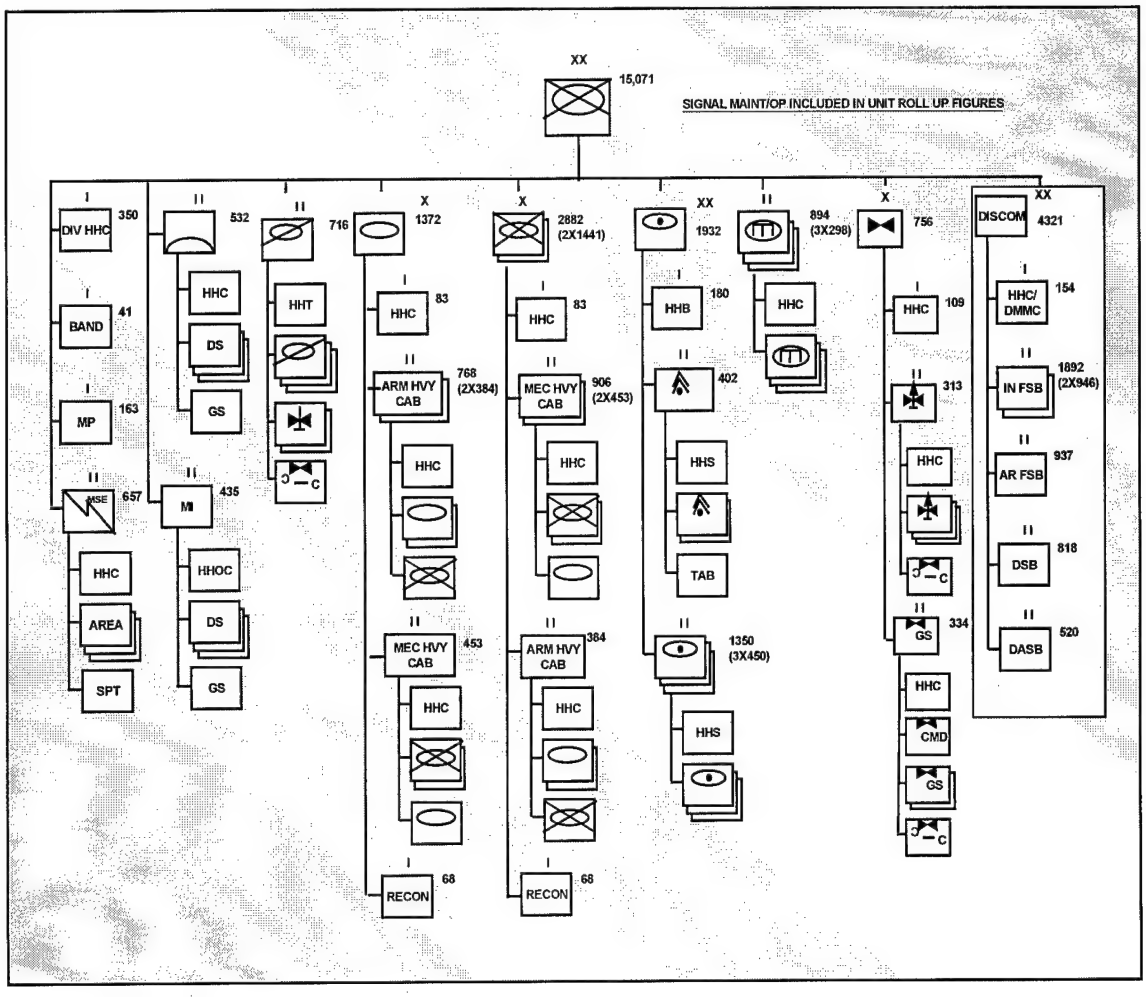


FIGURE P3-1: CHD Division

b. ***The STK Design***. The STK Design, shown in Figure P3-2, includes 14,574 personnel. This design consists of two ground maneuver brigades (with four CABs each), and the Strike Brigade which integrates aviation and light infantry assets. The STK design includes more long-range fire capabilities than either the CHD or the BDT design. The STK design's CSS concept and structure closely follow that prescribed for the CHD although this DISCOM contains fewer personnel (3,952).

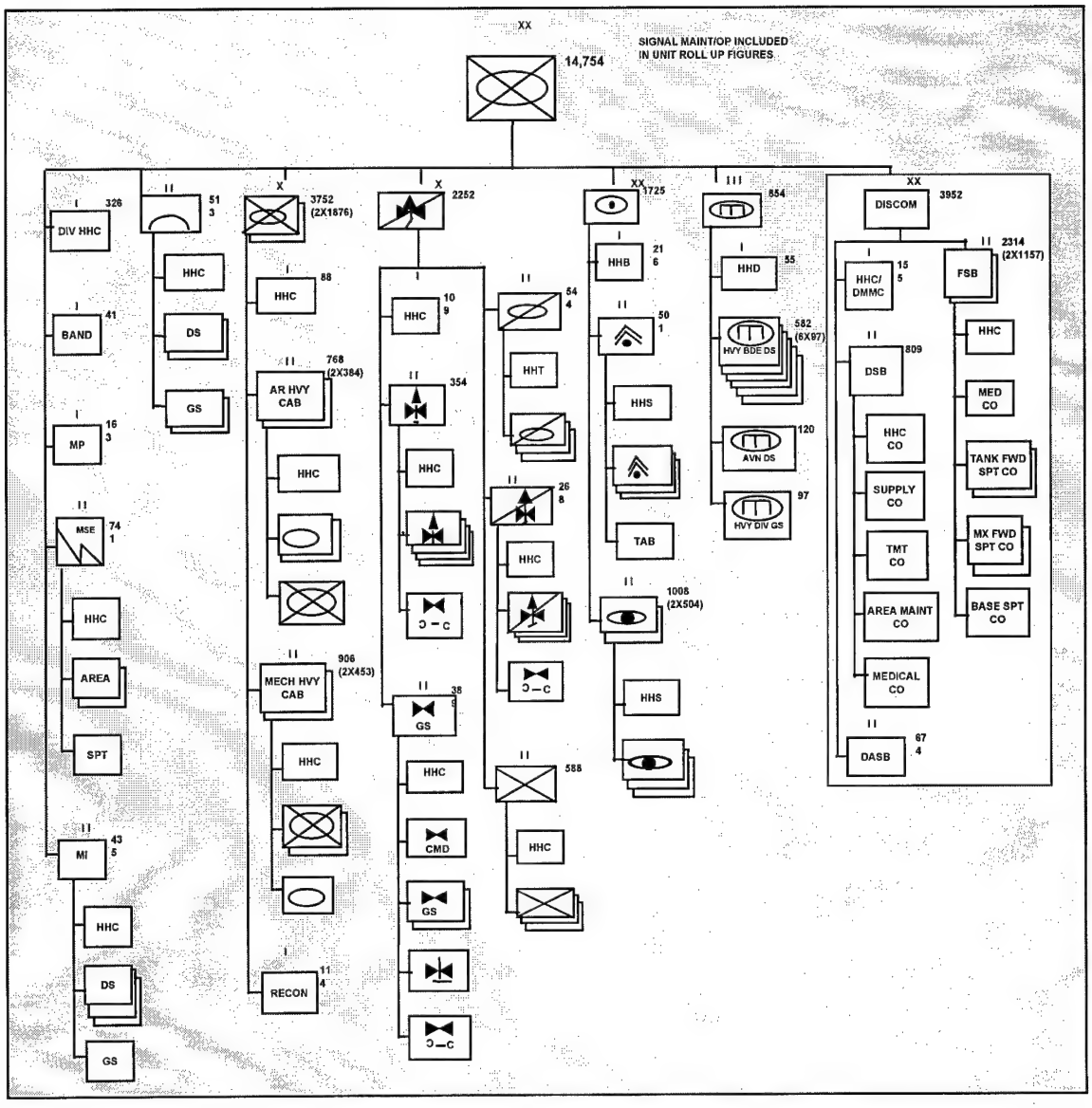


FIGURE P3-2: STK Division

c. ***The BDT Design***. The BDT design, built around three semi-autonomous brigades, contains 13,950 personnel as shown in Figure P3-3. Most of the traditional CS and CSS elements are organic to the brigade and not the division base. That is, cavalry, engineers, signal, military intelligence (MI), and ADA are organic to the maneuver brigades. The major exception is direct support field artillery, which still resides in a DIVARTY. This division has only one MLRS battery and no striker assets. Major division based functions that have been reduced, eliminated, or passed to EAD include DISCOM, counter-battery, deep fires, division-level ground cavalry, and signal support. The FSB CSS assets for the maneuver brigades and the DIVARTY are embedded in the respective units. The total number of CSS personnel embedded in this design is 4,274.

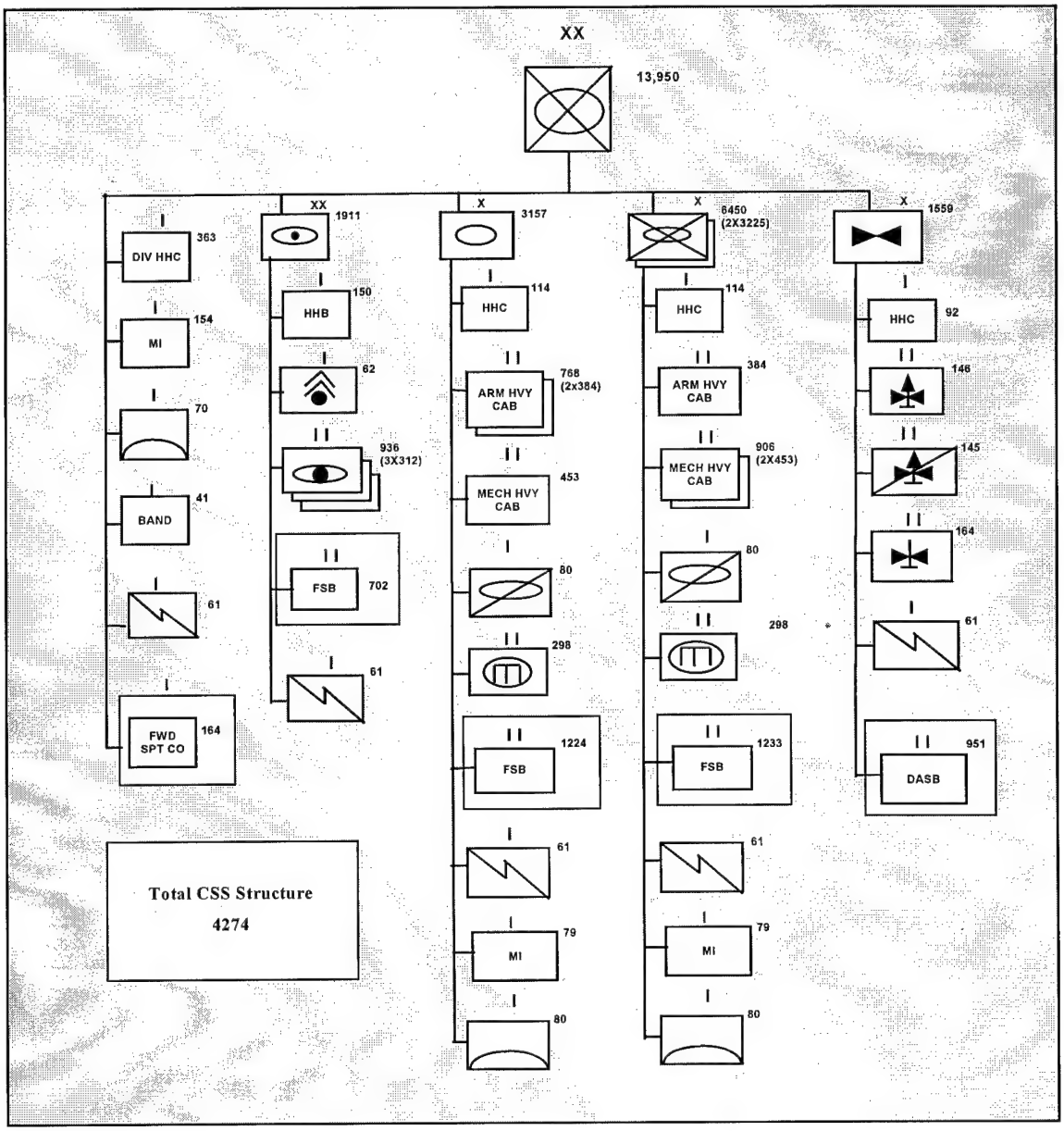


FIGURE P3-3: BDT Division

1.5. Scenario Overview. The LANTICA 3, NEA 2.0 and SWA scenarios underlie the simulations used in this analysis. The summary in Figure P3-4 describes the spectrum of scenario conditions. Each division design has a different employment concept. Consequently, each required its own course of action (COA) for each scenario. This resulted in nine different division battles for analysis.

	Lantica	NEA	SWA
Type Operation	Movement, pursuit, attack	Counterattack	Defense
Threat Technology	Low to high	Low to Moderate	Moderate to High
Corps Augmentation	Full	Partial	None
Span of Operations	300+ Km	70+ Km	Defense
Airspace Condition	Parity	Blue theaterwide	Blue local
Joint Contributions	USAF	USAF	USAF, USN
Scenario Source	Force XXI DDA	JCSEEA (modified)	JCSEEA (modified)

FIGURE P3-4: Scenario Bases for DDA - Phase III

a. ***LANTICA 3.*** The LANTICA 3 scenario is a vignette modification of the Division AWE scenario. In this vignette, the Blue forces perform an attack and pursuit of a low technology border force and then a counterattack against second echelon divisions of a high technology Combined Arms Army. The scenario begins with Blue air parity and improves to local air superiority. The Blue force maneuvers over 300 kilometers in this operation. The scenario is built around a Blue corps with two heavy divisions (one of which is the CHD), an Air Cavalry Regiment (ACR), five FA brigades and a corps attack aviation regiment.

b. ***NEA.*** The NEA scenario is an adaptation from the Joint Close Support End-to-End Analysis (JCSEEA). The war-fight is a counterattack involving a heavy corps with two heavy divisions, a light infantry division, a corps attack regiment, and an ACR as the major combat units. This scenario begins with the Infantry Division as the main effort. Once the Infantry division has secured the crossing sites, the ACR becomes the main effort, attacks, and establishes a guard. Finally, the heavy divisions assume the main effort. The restrictive terrain in this scenario limits the Blue heavy division's freedom of maneuver.

c. ***SWA***. The SWA scenario is also a variation of the JCSEEA work. This scenario depicts a short notice contingency operation, with a Force XXI division drawing equipment from pre-positioned stock. This division is the only U.S. ground combat unit in theater. The U. S. Air Force and the U. S. Navy elements provide the EAD CS forces. The Blue division's mission is to defend in sector to protect key facilities and to provide time for the arrival of additional Blue reinforcement. This division defends against an attacking threat provisional army.

1.6. Constraints and Limitations. The CSS analysis constraints and limitations, identified in DDA - Phase II Study documentation, apply to Phase III Division CSS analysis.

1.7. Assumptions. All assumptions stated in DDA - Phase II study documentation apply to Phase III analysis.

1.8. Study methodology. Figure P3-5 provides an overview of the DDA - Phase III analysis process. TRAC modeled each of the three candidate division designs (CH, STK, and BDT) within the context of three scenarios (LANTICA 3, NEA, and SWA). Output from these simulations, along with insights from the Operations Other Than War (OOTW) Seminar War Game and Concepts Analysis Agency (CAA) Theater Level Analysis, provided the basis for comparing the combat effectiveness of the candidate division designs. **The Division CSS analysis investigated the Force XXI CSS concept, based on consumption data from the constructive simulations.** The CSS analysis focused on each candidate division design's supportability within the context of the overall force.

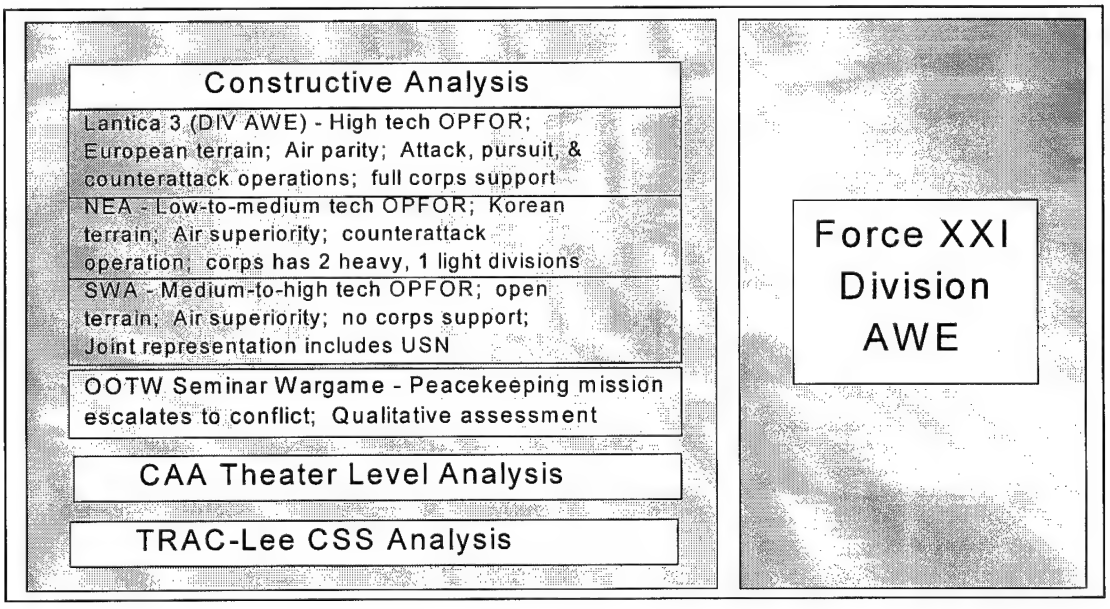


FIGURE P3-5: DDA – Phase III Study Methodology

a. ***Qualitative Analysis***. Using the "Right Size" DISCOM methodology described in the DDA – Phase II CSS analysis documentation, CASCOM provided draft CSS input for the VIC modeling of the CHD design. As in DDA - Phase II, the analytical bases for reviewing the

CHD's CSS design were MARC, planning factors, and SME judgement. Compressed DDA - Phase III timelines precluded a CSS community review of the CSS structure in the STK and BDT designs. The SMEs from TRADOC's Centers/Schools and CASCOM participated in course of action (COA) workshops hosted by the DDA study director. These workshops provided the forum for proponent input to the VIC modeling process. Using feedback from the COA workshops, TRAC modelers completed the nine production runs (three designs by three scenarios).

b. ***Quantitative Analysis***. The CSS data generated during VIC gaming provide the basis for comparing the three candidate division CSS structures. *DDA - Phase III CSS Analysis of VIC Dynamic Gaming Technical Reports*, on file at TRAC-Lee, provide in-depth documentation of the results of each of the nine simulations. The consumption and supply data associated with each design was summarized and reported in 4-hour blocks called Time Periods (TP). Maneuver unit stock balances over time serve as the primary measure of effectiveness. A lack of zero stock balances throughout the supply system is considered a positive indicator of the CSS system's ability to meet demands in a "timely" manner.

c. ***Definition of Terms***. The definition of the terms "reorder assessment cycle," "standard resupply," and "emergency resupply" delineated in DDA - Phase II, Chapter 1, paragraph 1.9.d. apply to DDA - Phase III analysis.

DDA Phase III
Division CSS Analysis
Final Report

CHAPTER 1
Introduction

1.1. Purpose. Division CSS analysis completed during DDA - Phase III considered the supportability of the three candidate division structures approved for analysis by the CG, TRADOC in May 1997. This analysis assesses each CSS design in the context of the Force XXI Division Operations Concept and compares their relative performances. Insights gleaned from DDA - Phase III Division CSS Analysis address the overarching JV issue # 2: "**How does the new CSS concept contribute to the effectiveness of the force?"** These insights, along with earlier insights documented in DDA Phases I and II, contributed to TRAC's assessment of this issue.

1.2. Background. The DDA - Phase I Division CSS analysis consisted of purely qualitative insights gleaned from SME surveys and CSS planning factor calculations. At the end of this phase in December 1995, the CG TRADOC chose the IDD for further analysis and experimentation. The second phase of DDA was conducted from January 1996 through May 1997. This phase included both qualitative and quantitative analyses. Insights from DDA - Phase II, the Task Force XXI AWE, and CASCOM's "Right Size" DISCOM initiative pointed to possible deficiencies in the proposed IDD. Additionally, further guidance capped the overall end strength of the Force XXI Division at 15,000. Emerging insights and the end-strength cap established a need for additional analysis. During May 1997, the CG, TRADOC approved three new division designs (CHD, STK, and BDT) for further analysis and experimentation.

1.3. Scope. The DDA - Phase II study issues were carried over for DDA - Phase III analysis. The third phase of the DDA continued to focus on the CSS concept's ability to support the offensive orientation of the Force XXI Division operations concept. Phase III analysis addressed the three candidate division designs noted in paragraph 1.2 above. The basis of each design is an objective force employing 2010 technology. Output from the CSS modules of the VIC model provided the analytical basis for this assessment.

1.4. Concept and Force Structure. As noted in DDA - Phase II, the Force XXI division operations concept, described in TRADOC Pam 525-71, *Force XXI Division Operations Concept*, March 1996, serves as the foundation for analyzing all proposed organizational designs for the Force XXI division. The basis of each candidate Force XXI design is an objective force employing 2010 technology. A graphic depiction and a brief overview of the candidate designs examined in Phase III (CHD, STK, and BDT) follow. The highlighted section in each figure represents the division's CSS structure, which is the focal point of the DDA - Phase III Division CSS analysis. The combat, CS and CSS augmentation available from corps differed among the scenarios because of tailoring for the specific warfighting conditions. See the DDA – Phase III main report for a detailed description of the force structures modeled.

a. ***The CHD Design***. This design is a modification of the IDD, selected by the CG TRADOC in December 1995 and evaluated in DDA - Phase II. There are 15,071 personnel in the CHD Mechanized Infantry variant as shown in Figure P3-1. The CHD structure is similar to that proposed for the IDD with three major exceptions. First, the maneuver battalions are built as three-company, armor and mechanized infantry combined arms battalions (CABs). Second, the CHD eliminates an engineer group headquarters. Finally, the CHD DISCOM differs from that of the IDD. The CHD DISCOM, with 4,321 personnel, is larger than that of the IDD. This DISCOM includes a DASB separate from the DSB. Engineer Support Platoons, located in the BSC of the FSB, replace the CSS assets previously located in the Engineer battalion.

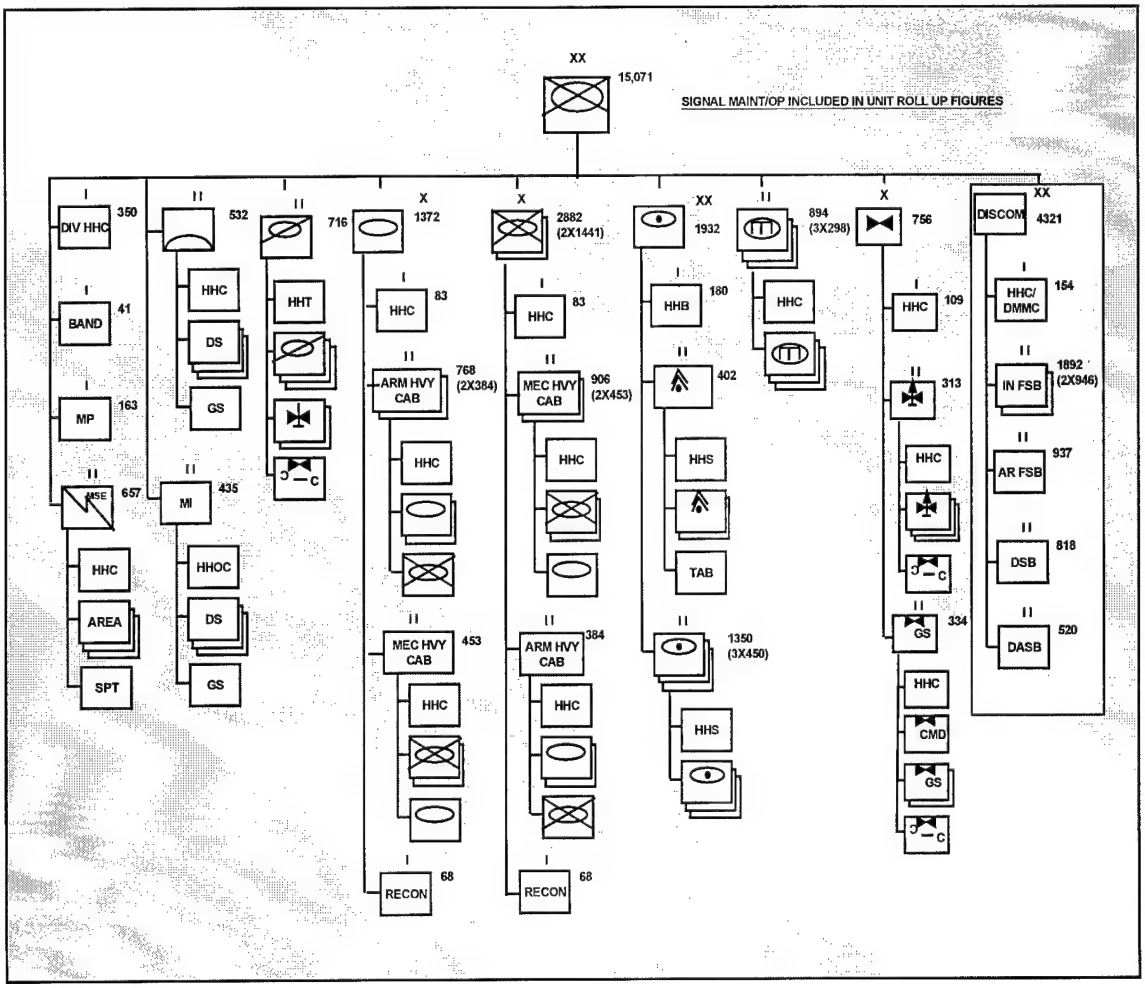


FIGURE P3-1: CHD Division

b. ***The STK Design***. The STK Design, shown in Figure P3-2, includes 14,574 personnel. This design consists of two ground maneuver brigades (with four CABs each), and the Strike Brigade which integrates aviation and light infantry assets. The STK design includes more long-range fire capabilities than either the CHD or the BDT design. The STK design's CSS concept and structure closely follow that prescribed for the CHD although this DISCOM contains fewer personnel (3,952).

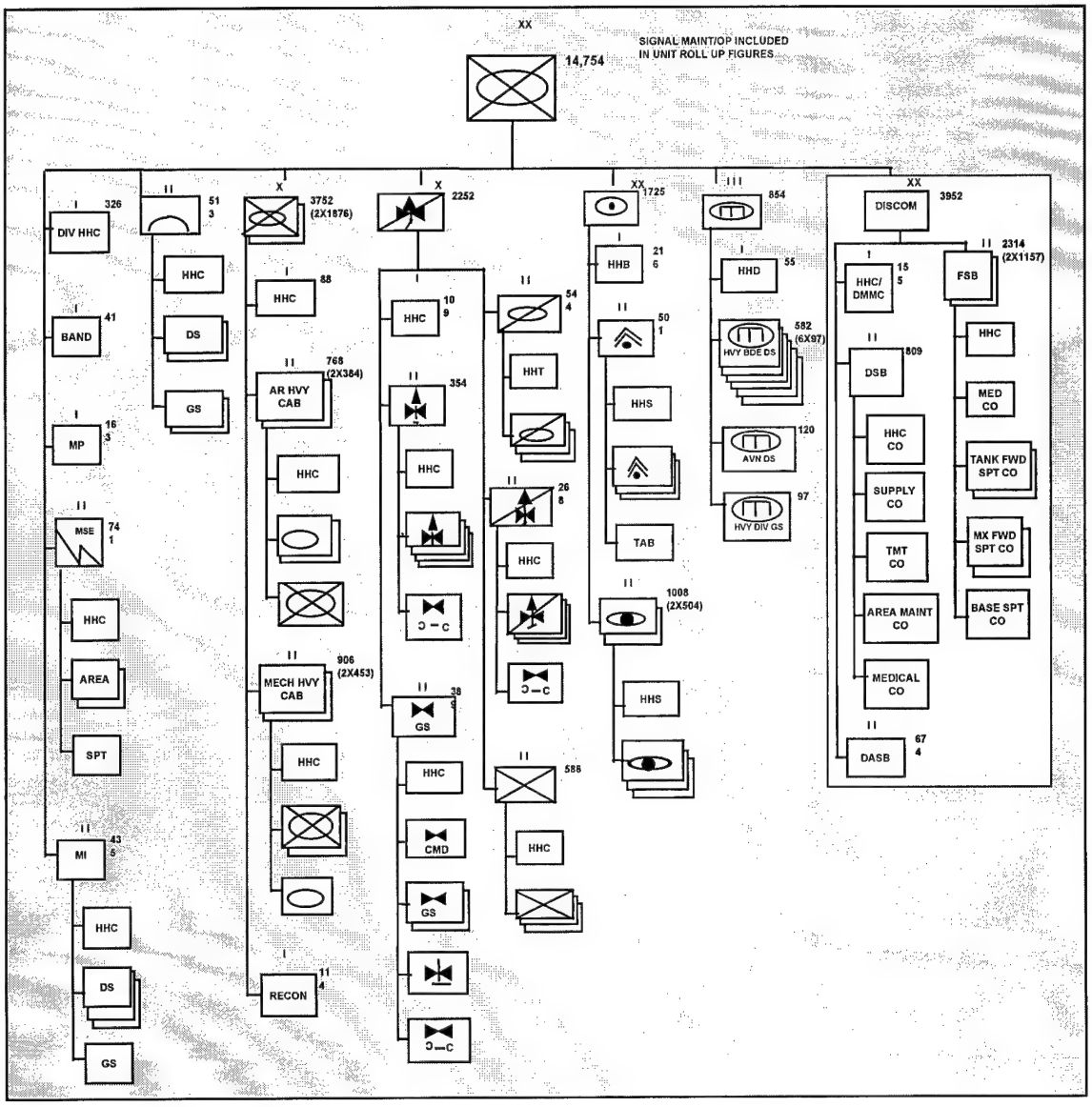


FIGURE P3-2: STK Division

c. ***The BDT Design***. The BDT design, built around three semi-autonomous brigades, contains 13,950 personnel as shown in Figure P3-3. Most of the traditional CS and CSS elements are organic to the brigade and not the division base. That is, cavalry, engineers, signal, military intelligence (MI), and ADA are organic to the maneuver brigades. The major exception is direct support field artillery, which still resides in a DIVARTY. This division has only one MLRS battery and no striker assets. Major division based functions that have been reduced, eliminated, or passed to EAD include DISCOM, counter-battery, deep fires, division-level ground cavalry, and signal support. The FSB CSS assets for the maneuver brigades and the DIVARTY are embedded in the respective units. The total number of CSS personnel embedded in this design is 4,274.

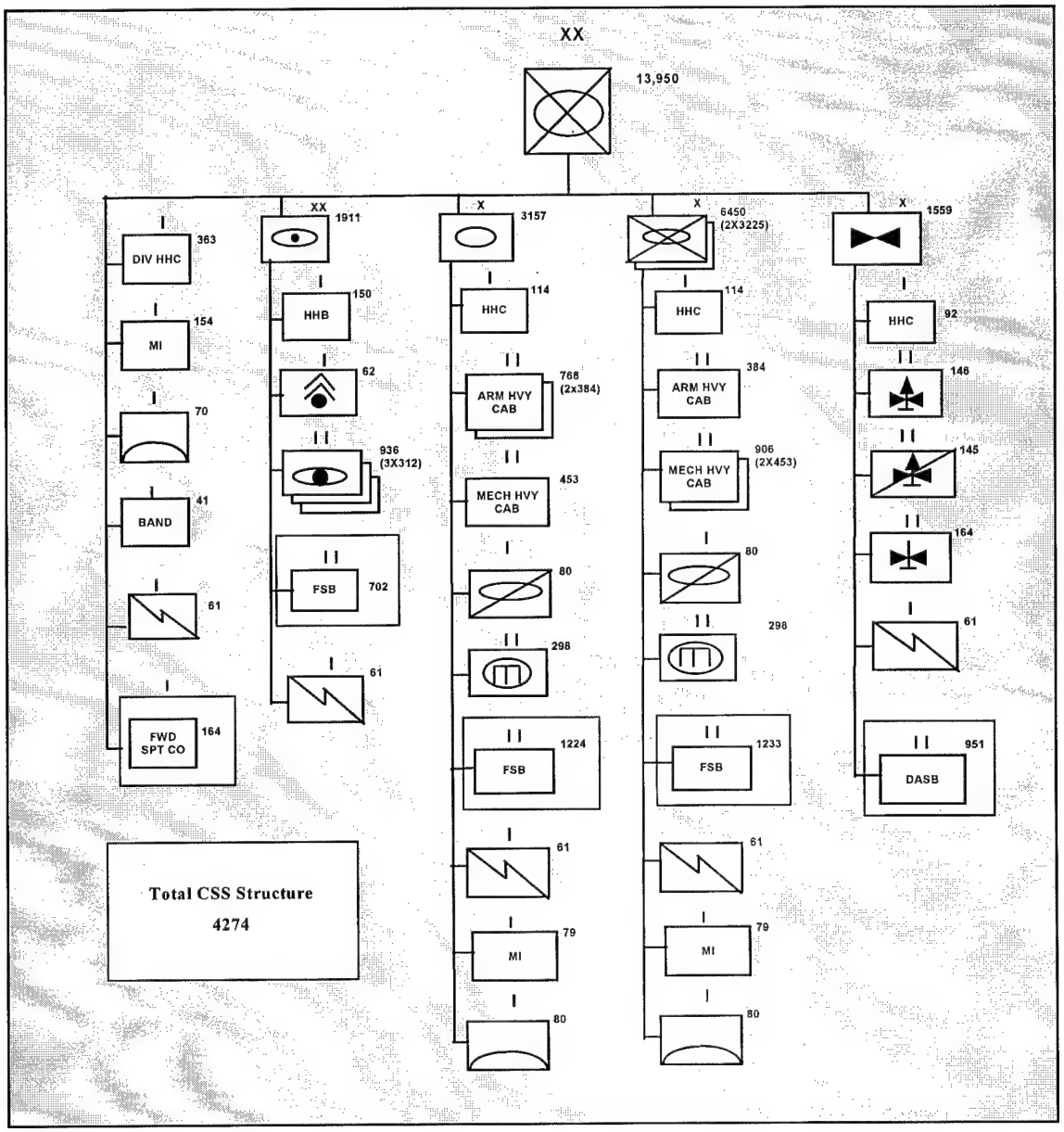


FIGURE P3-3: BDT Division

1.5. Scenario Overview. The LANTICA 3, NEA 2.0 and SWA scenarios underlie the simulations used in this analysis. The summary in Figure P3-4 describes the spectrum of scenario conditions. Each division design has a different employment concept. Consequently, each required its own course of action (COA) for each scenario. This resulted in nine different division battles for analysis.

	Lantica	NEA	SWA
Type Operation	Movement, pursuit, attack	Counterattack	Defense
Threat Technology	Low to high	Low to Moderate	Moderate to High
Corps Augmentation	Full	Partial	None
Span of Operations	300+ Km	70+ Km	Defense
Airspace Condition	Parity	Blue theaterwide	Blue local
Joint Contributions	USAF	USAF	USAF, USN
Scenario Source	Force XXI DDA	JCSEEA (modified)	JCSEEA (modified)

FIGURE P3-4: Scenario Bases for DDA - Phase III

a. ***LANTICA 3.*** The LANTICA 3 scenario is a vignette modification of the Division AWE scenario. In this vignette, the Blue forces perform an attack and pursuit of a low technology border force and then a counterattack against second echelon divisions of a high technology Combined Arms Army. The scenario begins with Blue air parity and improves to local air superiority. The Blue force maneuvers over 300 kilometers in this operation. The scenario is built around a Blue corps with two heavy divisions (one of which is the CHD), an Air Cavalry Regiment (ACR), five FA brigades and a corps attack aviation regiment.

b. ***NEA.*** The NEA scenario is an adaptation from the Joint Close Support End-to-End Analysis (JCSEEA). The war-fight is a counterattack involving a heavy corps with two heavy divisions, a light infantry division, a corps attack regiment, and an ACR as the major combat units. This scenario begins with the Infantry Division as the main effort. Once the Infantry division has secured the crossing sites, the ACR becomes the main effort, attacks, and establishes a guard. Finally, the heavy divisions assume the main effort. The restrictive terrain in this scenario limits the Blue heavy division's freedom of maneuver.

c. ***SWA***. The SWA scenario is also a variation of the JCSEEA work. This scenario depicts a short notice contingency operation, with a Force XXI division drawing equipment from pre-positioned stock. This division is the only U.S. ground combat unit in theater. The U. S. Air Force and the U. S. Navy elements provide the EAD CS forces. The Blue division's mission is to defend in sector to protect key facilities and to provide time for the arrival of additional Blue reinforcement. This division defends against an attacking threat provisional army.

1.6. Constraints and Limitations. The CSS analysis constraints and limitations, identified in DDA - Phase II Study documentation, apply to Phase III Division CSS analysis.

1.7. Assumptions. All assumptions stated in DDA - Phase II study documentation apply to Phase III analysis.

1.8. Study methodology. Figure P3-5 provides an overview of the DDA - Phase III analysis process. TRAC modeled each of the three candidate division designs (CH, STK, and BDT) within the context of three scenarios (LANTICA 3, NEA, and SWA). Output from these simulations, along with insights from the Operations Other Than War (OOTW) Seminar War Game and Concepts Analysis Agency (CAA) Theater Level Analysis, provided the basis for comparing the combat effectiveness of the candidate division designs. **The Division CSS analysis investigated the Force XXI CSS concept, based on consumption data from the constructive simulations.** The CSS analysis focused on each candidate division design's supportability within the context of the overall force.

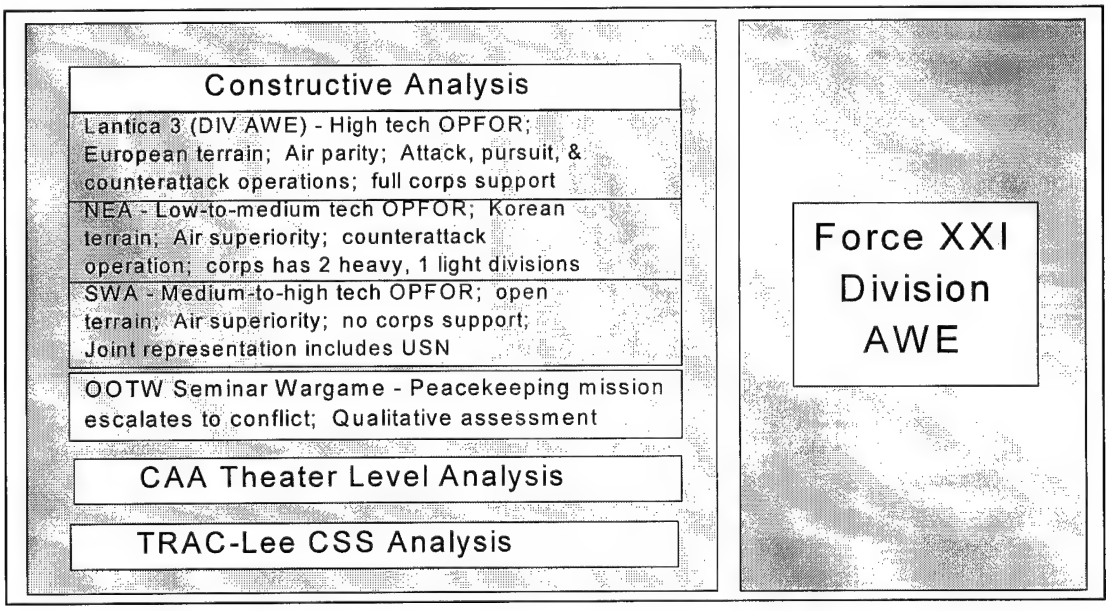


FIGURE P3-5: DDA – Phase III Study Methodology

a. ***Qualitative Analysis***. Using the "Right Size" DISCOM methodology described in the DDA – Phase II CSS analysis documentation, CASCOM provided draft CSS input for the VIC modeling of the CHD design. As in DDA - Phase II, the analytical bases for reviewing the

CHD's CSS design were MARC, planning factors, and SME judgement. Compressed DDA - Phase III timelines precluded a CSS community review of the CSS structure in the STK and BDT designs. The SMEs from TRADOC's Centers/Schools and CASCOM participated in course of action (COA) workshops hosted by the DDA study director. These workshops provided the forum for proponent input to the VIC modeling process. Using feedback from the COA workshops, TRAC modelers completed the nine production runs (three designs by three scenarios).

b. ***Quantitative Analysis***. The CSS data generated during VIC gaming provide the basis for comparing the three candidate division CSS structures. *DDA - Phase III CSS Analysis of VIC Dynamic Gaming Technical Reports*, on file at TRAC-Lee, provide in-depth documentation of the results of each of the nine simulations. The consumption and supply data associated with each design was summarized and reported in 4-hour blocks called Time Periods (TP). Maneuver unit stock balances over time serve as the primary measure of effectiveness. A lack of zero stock balances throughout the supply system is considered a positive indicator of the CSS system's ability to meet demands in a "timely" manner.

c. ***Definition of Terms***. The definition of the terms "reorder assessment cycle," "standard resupply," and "emergency resupply" delineated in DDA - Phase II, Chapter 1, paragraph 1.9.d. apply to DDA - Phase III analysis.

DDA Phase III
Division CSS Analysis
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CHAPTER 2
Results and Analysis

2.1. Contribution of the CSS concept to the effectiveness of the force: Ability to support the offensive orientation of the Force XXI Division operations concept and ability to support the Force XXI Division for reorganization for follow-on operations. Based on the results of the VIC modeling, the Force XXI division CSS concept is feasible in all designs and scenarios, given the presence of CSS enablers, fully resourced corps support, and the limited duration of the scenarios examined. The combat elements of all Force XXI division designs, along with their Corps CS slices, accomplished the missions outlined in each scenario. However, in all designs, critically low stockage levels at the end of the initial battle, particularly in the area of FA Class V, could limit the division's ability to exploit success and complete follow-on operations.

a. ***Class III.*** The maneuver elements received Class III resupply in a "timely" fashion in all designs and across all scenarios. A lack of fuel did not impede mission accomplishment. Fuel stockage levels did not fall to zero in any unit. However, in the LANTICA 3 scenario, both the CHD and the STK divisions exhibited high levels of resupply risk for follow-on missions. Fuel stockage balances in their respective DSBs reached critical levels before resupplies arrived. Total consumption and the consumption pattern for each design reflect the force structure and employment concept associated with the respective design. In each design, there were instances when the fuel balance in at least one unit fell below 50% of that unit's authorization thereby triggering an "emergency" resupply request. Figure P3-6 depicts the number of "emergency" resupply requests placed by units within the respective division design. These tallies include the number of "emergency" resupply requests that the CHD and the STK DSB placed on supporting Corps units. The BDT design does not include a DSB. The lengthening LOC was the primary factor causing the large number of "emergency" resupply requests in the LANTICA 3 scenario.

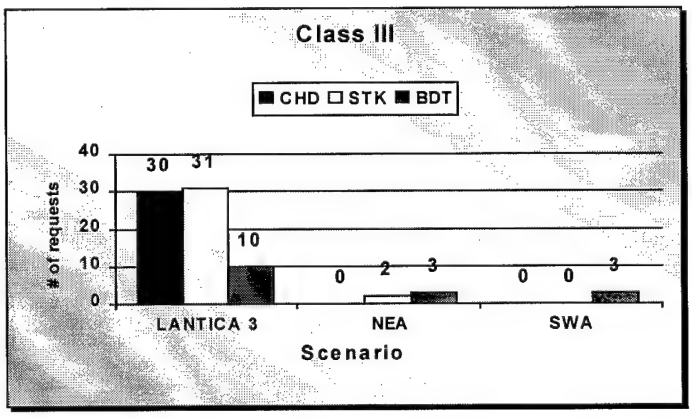

FIGURE P3-6: Class III "Emergency" Resupply Requests in the Division.

(1) LANTICA 3. From a Class III perspective, the LANTICA 3 scenario stressed the CSS system's ability to support the offensive orientation of the Force XXI division operation concept. The lengthening LOC associated with this scenario was a primary factor causing the large number of "emergency" resupply requests. Two DIVARTY battalions in the STK design ended the scenario with less than 10% of authorized Class III stocks on hand. At the DSB level, both the CHD and the STK divisions exhibited high levels of resupply risks. The DSB in the CHD design exhausted its entire fuel stockage before resupply arrived. Class III stockage levels at the DSB reached a low of 2% in the STK design. Although fuel stock levels for Armor and Mechanized Infantry battalions did not fall below 30%, these units experienced some resupply risk as well. Twenty-two (22) of the CHD design's and 10 of the STK design's "Emergency" resupply incidents occurred because the fuel balance in one or more of the supported battalions was between 30% and 50%. While responding to the demand generated by this scenario, the FSCs in all designs experienced short-term Class III shortages. Several FSCs did not have enough fuel on hand to immediately provide 100% of the Class III requested.

(2) NEA & SWA. From a Class III perspective, these two scenarios did not stressed the CSS system's ability to support the offensive orientation of the Force XXI division operation concept. The number of "emergency" resupply incidents was minimal. Fuel balances in all units and across all designs remained above 50% throughout both the NEA and the SWA scenarios.

b. ***Class V.*** All division designs were supportable within the context of the three scenarios examined. A lack of ammunition did not impede mission accomplishment. The FSC concept adequately supported the Armor and Mechanized Infantry units in each design and across all scenarios. However, low FA munitions end-state stock levels in the LANTICA 3 scenario (shown in Figure P3-7) indicate potential risks may be associated with the conduct of follow-on operations. The Force XXI operational concept's heavy reliance on deep fires caused artillery units to consume ammunition faster than the CSS system could resupply them. Consequently, FA resupply dominated the Class V resupply mission. The DIVARTY in each design experienced numerous "emergency" resupply incidents (shown in Figure P3-8). On several occasions, these incidents included zero balances for one or more primary munitions. Although this analysis focuses on the division, the CSS system also experienced problems meeting Corps artillery resupply requests. There were instances when one or more Corps FA units experienced zero balances for one or more primary munitions types.

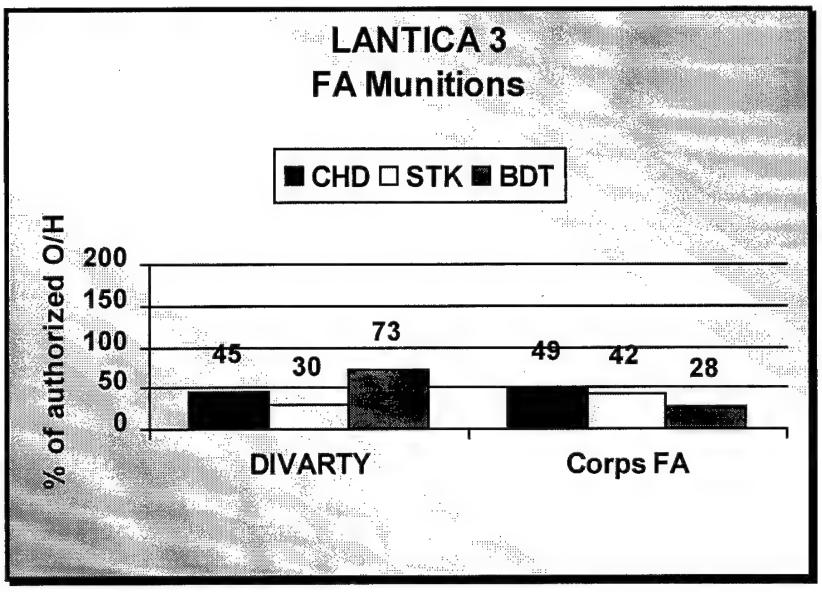

FIGURE P3-7: LANTICA 3 - FA Munitions End-State Stockage Level

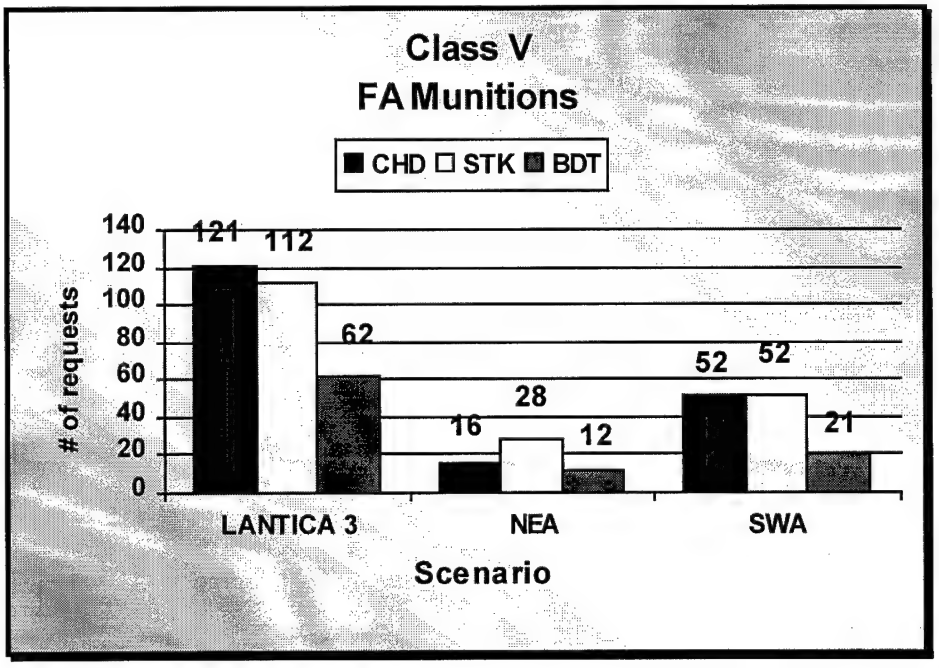

FIGURE P3-8: Class V FA Munitions "Emergency" Resupply Incidents in the Division

(1) LANTICA 3. Based on the VIC simulation data, all designs were supportable for the 48-hour war-fight outlined in this scenario; however, maneuver unit consumption of Class V did not stress the FSC concept.

(a) The DIVARTY placed approximately 90% of the division's Class V "emergency" resupply requests. The number of FA Class V "emergency" resupply incidents (shown in Figure P3-8) experienced during the gaming of each design highlight differences between the individual designs and their associated concepts of employment. The BDT design emphasizes the close fight. Consequently, FA consumption rates were not as high as when employing either the CHD or the STK designs. Consequently, the BDT design appears to present the least risks for follow-on operations. Approximately 75% of authorized 155mm munitions were on-hand at the end of the scenario. Because of their emphasis on deep fires, both the CHD and the STK design received less Class V support than the BDT design. The 155mm munitions end-state stockage level for each of these division designs was below 50%. Additionally, both experienced approximately twice the number of "emergency" resupply requests as BDT.

(b) Of the three designs, the BDT placed the greatest burden on the FSC, consuming three times as much 120mm munitions as the CHD, and eight times as much as the STK design. The BDT design experienced short-term FSC stock shortages for two munitions types: 120mm (PGMM and M929) and 25mm. These FSC shortages did not cause similar shortages in the maneuver units. At end-state, on-hand stockage levels for 120mm and 25mm munitions were adequate for the number of available systems.

(2) NEA. The respective Division CSS structures supported the three candidate designs within the context of this scenario. The end-state stockage level for all munitions, except MLRS, was greater than 75%. The number of "emergency" resupply requests (shown in Figure P3-8) was minimal. The DIVARTY placed at least 60% of the division's "emergency" Class V resupply requests across all designs. Aviation and ground maneuver units placed the remaining 40%. The types of munitions ordered by the non-DIVARTY units reflect differences among the candidate designs. In both the CHD and the BDT designs, low 120mm munitions stock levels triggered the remaining 40% of "emergency" requests. Responding to these requests induced short-term stock shortages in several FSCs. The shortages were not severe enough to cause 120mm munitions stock levels in any CHD or BDT maneuver unit to drop below the "emergency" threshold of 50% on-hand. Because of the aviation and light infantry emphasis in the STK design, 10% of "emergency" resupply requests were for LONGBOW, Stinger, and Javelin munitions. Requests for 120mm munitions made up the remaining 30%. One division Cavalry Squadron experienced a zero balance for both Javelin and 120mm munitions.

(3) SWA. In the context of the SWA scenario, the respective Division CSS structures supported each of the candidate designs. Naval combat support relieved much of the Army's deep fires burden. Yet, the division's need for FA munitions dominated resupply operations across all designs. The DIVARTY placed over 90% of all division Class V "emergency" resupply requests. The graph in Figure P3-8 shows that the proportions of "emergency" resupply incidents in the SWA scenario mirrored the LANTICA 3 experience. Both the CHD and the STK designs experienced approximately twice the number of FA "emergency" resupply requests as BDT. Consequently, the BDT design appears to present the least risk. However, the BDT design contains fewer FA assets. This design consumed less Class V, thereby placing the smallest burden on FA resupply operations. In this case, fewer "emergency" resupply requests reflect differences between the individual design structures and their associated concepts of employment, and not the CSS system's ability to support.

2.2. Effects of the Force XXI CSS concept on logistical operations. Of the three scenarios examined, the LANTICA 3 scenario placed the most stress on the Force XXI CSS concept and force structure. Long LOCs and MSR congestion hampered "timely" re-supply and highlighted the need for anticipatory logistics. However, the analytical model used in this analysis does not currently represent anticipatory logistics, and the CSS EAD design for Force XXI is under development. As a result, more analysis will be required to assess fully the robustness of the Force XXI division CSS concept.

a. ***Class III.***

(1) LANTICA 3. Table P3-1 provides a summary of consumption and resupply activity across the designs. In this scenario, each of the candidate Force XXI CSS designs supported Class III resupply requirements in a "timely" fashion. When the scenario ended at H+96, over 80% of all Class III orders had been shipped and at least 75 % had been received. In spite of apparent supportability, both the CHD and the STK divisions exhibit high levels of resupply risk for follow-on missions. Fuel stockage balances in their respective DSBs reached critical levels before resupplies arrived. Corps CSS units experienced problems delivering to CSS elements in the division.

TABLE P3-1: Class III Resupply – LANTICA 3

	CHD (gallons)	**STK** (gallons)	**BDT** (gallons)
Total Class III Consumption	582,473	532,621	601,715
Resupply			
Ordered	557,382	440,353	505,664
Shipped	449,921	422,381	434,017
Total Receipts	420,316	370,162	416,207
CSS System Performance			
% of orders shipped	81%	96%	85%
% of orders received	75%	84%	82%

(2) NEA. Table P3-2 provides a summary of consumption and resupply activity in the NEA scenario. None of the CSS designs experienced difficulty supporting the division elements. The high percentage of orders shipped and received during this scenario is an indicator that the supply stockage policy and the number of transporters modeled adequately support each of the division designs. It should be noted that the CSS system performance statistics of the NEA scenario depicted in Table P3-2 do not address support provided by Corps CSS units. In all designs, the Corps CSS units experienced problems delivering aviation fuel to Corps Aviation units supporting the division. The Corps CSS units also experienced problems delivering to CSS elements in the division. The primary culprit was a lack of transporters at Corps.

TABLE P3-2: Class III Resupply – NEA

	CHD (gallons)	**STK** (gallons)	**BDT** (gallons)
Total Class III Consumption	266,566	255,525	246,045
Resupply			
Ordered	51,822	97,819	152,688
Shipped	51,822	97,819	147,547
Total Receipts	45,013	81,972	105,625
CSS System Performance			
% of orders shipped	100%	100%	97%
% of orders received	87%	84%	69%

(3) SWA. The data summarized in Table P3-3 depicts consumption and resupply activity in the SWA scenario. None of the CSS designs experienced difficulty supporting their respective division design. In the SWA scenario, the ground maneuver units' consumption of Class III was not high enough to stress the CSS system. Fuel stockage levels in the ground maneuver units did not fall below 75% of authorizations during the scenario. Aviation units were the only maneuver elements requiring resupply. The CSS system did not experience difficulty fulfilling the aviation requests. With three exceptions, which occurred during gaming of the BDT design, aviation fuel balances did not reach "emergency" levels (drop below 50%) at any time during the scenario.

TABLE P3-3: Class III Resupply – SWA

	CHD (gallons)	**STK** (gallons)	**BDT** (gallons)
Total Class III Consumption	61,070	94,427	64,558
Resupply			
Ordered	15,337	27,800	38,828
Shipped	14,558	26,096	38,828
Total Receipts	0	22,700	36,328
CSS System Performance			
% of orders shipped	95%	94%	100%
% of orders received	0%	82%	94%

b. ***Class V.***

(1) LANTICA 3. Table P3-4 provides a summary of consumption and resupply activity across the three designs. All designs were supportable for the 48-hour war-fight outlined in this scenario. Air delivery of Class V was not required. Stockage policies and transportation asset availability allowed the CSS system to ship at least 87% of all ammunition requested. In spite of

the high shipment percentages, approximately half of all Class V munitions requested by both the CHD and the STK units had not been delivered when the scenario ended. The BDT design faired considerably better because the proportion of FA munitions requests was smaller. Still, end-state stockage levels for all division designs were below 75%. An inability to **anticipate** requirements (model limitation) and the long LOC (300km) associated with this scenario hampered "timely" resupply. The Class V resupply experience in this scenario highlights the need for anticipatory logistics.

TABLE P3-4: Class V Resupply – LANTICA 3

	CHD (STONS)	**STK** (STONS)	**BDT** (STONS)
Total Class V Consumption	1,666	2,071	1,721
Resupply			
Ordered	422	646	1,149
Shipped	421	592	1,005
Total Receipts	239	301	931
CSS System Performance			
% of orders shipped	100%	92%	87%
% of orders received	57%	47%	81%
Emergency receipts as a % of total receipts	0%	0%	0%

(2) NEA. Table P3-5 provides a summary of consumption and resupply activity across the three designs. The respective Division CSS structures supported the three candidate designs within the context of this scenario. Each design accomplished the mission although the CSS system delivered less than 60% of all Class V requested. More in-depth examination of the data highlighted potential risks that are not division design specific. "Emergency" air delivery of munitions played a significant role in Class V resupply operations as shown in Table P3-5. All designs relied on "emergency" air delivery of Class V to facilitate "timely" support. At least a quarter of all Class V deliveries occurred in this manner. The terrain in this scenario restricted transportation movements, and consequently, truck availability. In each design, supply shortages hampered some division resupply operations, while Corps truck shortages constrained FA munitions throughput. This scenario highlights the need to evaluate supply stockage policies and the EAD CSS design in an effort to reduce risk to follow-on operations.

TABLE P3-5: Class V Resupply – NEA

	CHD (STONS)	**STK** (STONS)	**BDT** (STONS)
Total Class V Consumption	2,176	1,768	1,423
Resupply			
Ordered	1,811	1,861	848
Shipped	1,044	1,218	696
Total Receipts	992	688	471
CSS System Performance			
% of orders shipped	58%	65%	82%
% of orders received	55%	37%	56%
Emergency receipts as a % of total receipts	33%	37%	24%

(3) SWA. Table P3-6 provides a summary of consumption and resupply activity across the three designs. The results of this scenario indicate that the CHD design is the most supportable of the three candidate division designs when a Force XXI division operates independently of its Corp support. However, the Force XXI division's dependence on Corps is highlighted by a high reliance on "emergency" air delivery of Class V across all designs. The CSS system in the CHD design shipped 89% of all ammunition requested and delivered over 80% by the end of the scenario. Yet, over 50% of all CHD Class V receipts were via air delivery. Although the CHD design's shipment and delivery percentages indicate a high degree of supportability, this system's reliance on air delivery emphasizes risks associated with each of the Force XXI CSS designs. When gaming the STK and the BDT designs, slightly more than half of all orders placed were shipped and approximately 40% were delivered during the 24-hour SWA scenario. In both of these designs, air delivery played an essential role in Class V resupply operations.

TABLE P3-6: Class V Resupply – SWA

	CHD (STONS)	**STK** (STONS)	**BDT** (STONS)
Total Class V Consumption	2,374	1,739	1,405
Resupply			
Ordered	883	499	606
Shipped	782	286	395
Total Receipts	716	212	249
CSS System Performance			
% of orders shipped	89%	57%	65%
% of orders received	81%	43%	41%
Emergency receipts as a % of total receipts	57%	36%	47%

CHAPTER 3
Conclusions and Recommendations

3.1. Conclusions. Based on modeling results, the Force XXI CSS concept appears to be feasible in all designs and scenarios, given the presence of CSS enablers, fully resourced corps support, and the limited duration of the scenarios examined. The respective combat elements of the Force XXI division design, along with their supporting Corps CS slices, were able to accomplish all missions. At no point in any of the scenarios did a lack of fuel or ammunition prevent a unit from successfully completing its mission. However, the division's ability to exploit success and to continue into the next battle may be limited by critically low stockage levels at the end of the initial battle, particularly in the area of field artillery class V. The stressful CSS environment encountered in the Lantica scenario demonstrates that the time-distance factors associated with extended LOCs and MSR congestion inhibit "timely" resupply. Results clearly indicate that TAV does not necessarily equate to "timely" support and highlight the need for **anticipatory** logistics.

3.2. Recommendations.

a. Additional analysis is needed to fully assess the robustness of the Force XXI division CSS concept. It is important to note that the VIC model does not represent anticipatory logistics. There is no man-in-the-loop to do the up-front planning necessary to be able to push resupplies forward at the right time and to appropriate positions on the battlefield in anticipation of requirements. The methodology used by VIC essentially represents a pull-system. However, the model did allow for near real time visibility of supply consumption (stockage levels are reviewed for every unit once an hour) and supplies were ordered whenever stockage levels reach predetermined thresholds.

b. In all scenarios, FA consumption rates stressed the Force XXI CSS concept, Corps throughput for class V resupply. A method for combating the problems associated with the extended LOCs and high FA firing rates, which are a part of the Force XXI operational concept, must be found. As the CSS concept continues to be refined, serious consideration should be given to extending the modular support FSC concept to both divisional and EAD artillery units operating in support of the division. At a minimum, the organic ATP capability of the CHD should be retained (18 spaces). Additionally, problems encountered in the NEA scenario highlight the need to evaluate supply stockage policies and the EAD CSS design. The stockage levels and placement of ASP support of the division should be re-evaluated.

c. Finally, MSR and rear-area security issues are a concern for all designs. In the LANTICA scenario, rapid maneuver extends LOCs out to 300 kilometers by the end of the scenario. In addition to the time-distance factor problems, this also raises serious security issues.

The loss of even a few resupply convoys will compound an already serious situation as units await critical through-put resupply from Corps. How and by whom LOCs will be secured are issues which must be addressed.